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THE GEOLOGICAL SOCIETY OF PUERTO RICO

721

INVENTORY

OF

POTENTIAL NATIONAL NATURAL LANDMARKS

IN

PUERTO RICO

Prepared for the National Park Service

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INVENTORY OF POTENTIAL NATIONAL NATURAL LANDMARKS IN PUERTO RICO

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Prepared for the National Park Service
1976

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Introduction

Puerto Rico - smallest of the Greater Antilles - is situated at their eastern end (Lat. 18°00'N, Long. 65°40' - 67°30'W) with Hispaniola lying to the west about 100 kilometers across the Mona Passage and the Virgin Islands about 50 kilometers to the east.

Puerto Rico itself is approximately rectangular in shape, stretching 170 kms. in the east-west direction and 60 kms. north to south. Three small islands - Culebra and Vieques to the east and southeast, Mona, in the middle of the passage to the west - and a number of smaller islets and cays are also included in Puerto Rican territory.

The island is within U.S. territory but has a unique relationship being a "Free Associated Commonwealth". Its inhabitants are U.S. citizens, but they do not have the right to vote for the Congress or the President and are represented by a Resident Commissioner in Washington. It is one of the more densely populated regions in the world with a population of a little under three million. Since the late 1940's it has become rapidly industrialized with a concomitant decline in agriculture.

Topography

Most of the island is fairly rugged and heavily vegetated. The central axis, the Cordillera Central consists of deeply dissected valleys and hills averaging about 800 m in elevation, the highest point being Cerro de Punta near the center at 1338 m. Slopes are generally extremely steep, in many places being as much as 60°. The main Cordillera trends WNW-ESE

across the island. The Sierra de Luquillo in the northeast is more or less cut off from the Cordillera by the Caguas lowland. It has two high peaks, El Toro (1079 m) and El Yunque (1065 m).

North of the Cordillera, a belt of spectacular Karst country approximately 30 km width extends from the west coast narrowing eastward near San Juan. It consists of very steep-sided small residual hills, sinkholes and other karstic features such as caves, underground drainage etc. The small hills are variously known as "haystack hills", "pepino hills" or "mogotes".

The drainage is chiefly toward the north, east and west with the divide being displaced southward of the center line. The major rivers draining northward have incised deep vertical-walled canyons as they flowed through the karst area. To the west three of the larger rivers flow into broad floodplains which are fault-bounded while in the southwest a fourth broad fault valley, the Lajas valley, contains only a very small stream at its western end.

Southward drainage from the Cordillera tends to be intermittent, many of the streams being reduced to a mere trickle for large parts of the year.

The lowland on the south coast (about ten kilometers or less in width) is a rather dry savannah-like area which, towards the west in particular, tends towards a cactus and scrub vegetation. Irrigation has brought a good deal of the dry area into cultivation.

Along the north coast particularly in the vicinity of Arecibo there is a narrow belt of dune topography.

The most conspicuous features of the coastal areas are coral reefs which flourish along most parts of the coast, except at the mouths of the larger rivers. In the south, barrier reefs shelter calm lagoons and small offshore coral islands abound. They are less extensive along the northern coast. In the southeast and northwest the coastline is fairly steep and rocky. Considerable surf from the Atlantic pounds the coast from San Juan westwards and down the west coast as far south as Rincon. There are a number of moderately good beach areas, especially along the small bays on the north coast and parts of the west coast. Mangrove swamps are a feature of many parts of the coastal areas.

The island is surrounded by a generally narrow shelf which extends southwestward about eight kilometers but is mostly narrower. Beyond the shelf the bottoms falls off steeply to considerable depths. Eastward the shelf extends to just beyond the Virgin Islands which are essentially part of the Puerto Rican "block".

The tidal range is very small with a maximum of about 45 cm. Of the offshore islands, Mona, in the middle of the Passage between Puerto Rico and the Dominican Republic is a steep-sided, flat-topped island, with its upper surface at just above about 50 m. It is extremely dry, with no streams; the vegetation is mainly scrub and cactus except on a low flat shelf on

the southwest corner where some woodland exists. There are no inhabitants except for a police post. Desecheo, a small steep conical island about 25 km. west of Puerto Rico is also dry and completely uninhabited.

Vieques and Culebra to the east are somewhat larger, fairly rugged islands which do support small human populations.

Climate

Because of Puerto Rico's geographic position the climate is of course tropical but there is considerable variation from one part of the island to another. Puerto Rico is in the northeast tradewind belt and consequently the winds blow almost continuously from the northeast although they are deflected to almost due east along the south coast. It is rare for winds to blow from any other direction, except for local onshore breezes in the west.

This wind pattern results in high precipitation in the north and northeast, while the south and southwest receive very little. Average annual rainfall varies from over 508 cm. in the El Yunque area in the northeast to about 76 cm. in the southwest. The annual wet (April-September) and dry (October-March) seasons which a few years ago were very distinct, have recently become rather less so. About ten years ago heavy rains fell very regularly in the early afternoons during the rainy season and were rare during the dry. Now such rains are much more irregular, may come at any time of the day and may continue through the winter season. Although heavy rains do occasionally oover

the whole island, in general they seem to be locally confined so that one watershed area will often receive considerable precipitation leading to flooding, while neighboring areas receive little or none at all.

Temperatures tend to remain equable, varying little from around 70-80°F.

During the season - July to October - there is the possibility of hurricanes. None have struck Puerto Rico since 1956, although several have passed close.

Industry and Agriculture

As mentioned previously, since the 1940's, rapid industrialization has led to a general decline in agriculture. Manufacturing businesses have been attracted, largely from the continental U.S., by tax exemptions and relatively low labor costs. Light industry, textiles, clothing, pharmaceuticals and electronic parts are the most common and almost every town in the island now has at least one or two small factories. Major concentrations are around the three largest cities of San Juan, Ponce and Mayaguez. Heavy industry is represented by oil refineries at Penuelas and Yabucoa the former being the center of a large petrochemicals complex. Cement making is also important with large plants at San Juan and Ponce.

The major crops are sugar, coffee and tobacco. Citrus fruits are common but are not developed systematically. Vegetable farming is also poorly developed. A large proportion of the foodstuff consumed on the island is imported, 100% in the

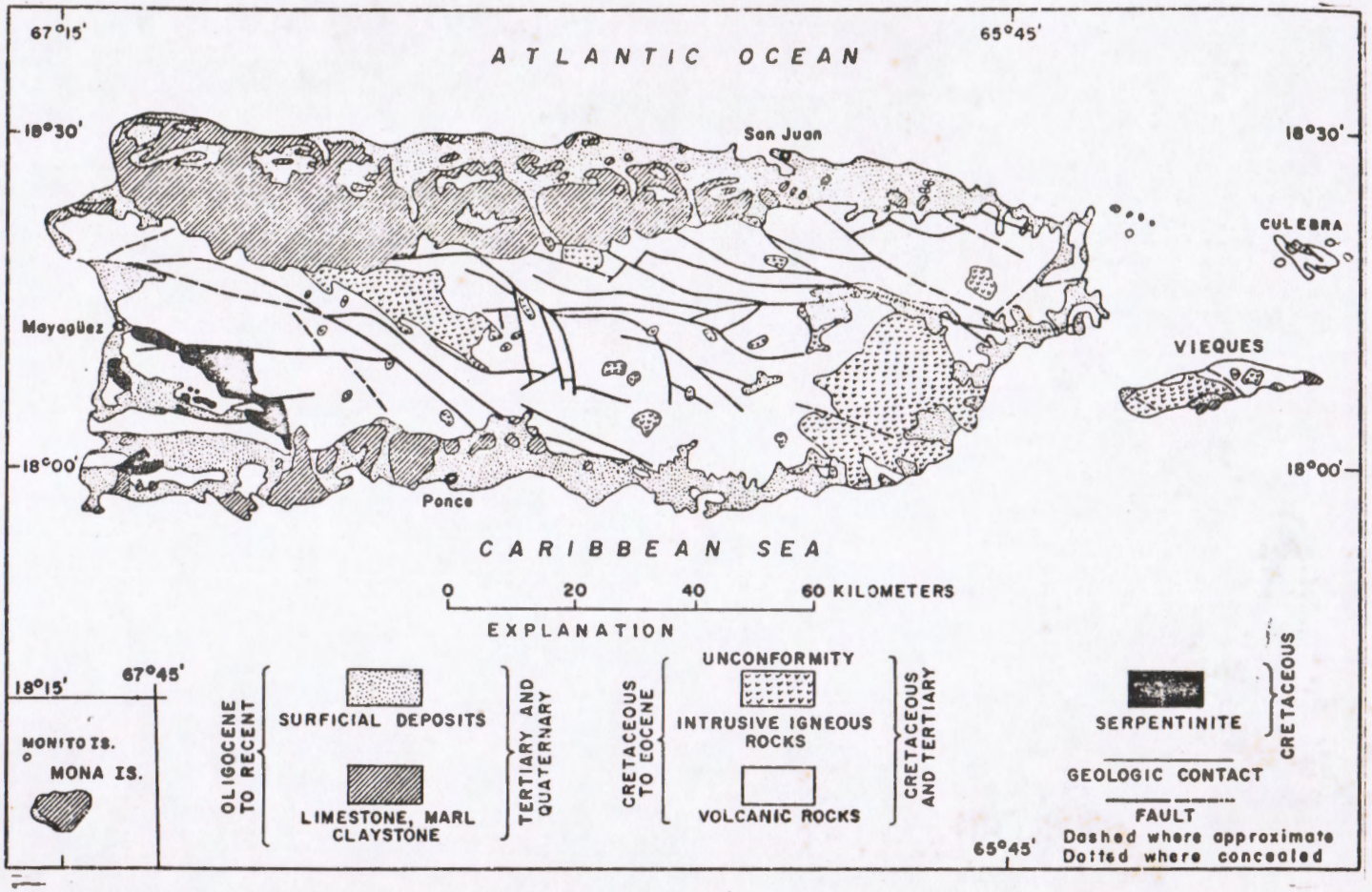

Fig.1. Generalised Geological Map of Puerto Rico. (Briggs,1969).

case of rice and beans which are major items. The sugar industry, once the main support of the economy, has been declining steadily over the past twenty years and most of the factories have closed down. Only two or three continue operation with government support. Puerto Rican coffee, which in the last century was highly prized in Europe, has been for a long time unable to compete on the foreign market, although quite a lot is produced for home consumption. The tobacco crops support a moderately successful cigar industry.

Cattle are raised in many parts of the island mainly for milk. The local beef is generally of inferior quality. Pork and poultry are fairly common though much has to be imported.

Puerto Rican rums are a considerable source of income. The island breweries are now finding difficulty in meeting competition from U.S. and foreign beers.

Geology

The rocks of Puerto Rico are sharply divided into two groups which can conveniently be referred to as the Older Series and the Younger Series.

The Older Series which form in the main part of the island, the Cordillera Central, are mainly composed of volcanic rocks, or volcanically derived sediments with some interbedded crystalline limestones. These rocks are considerably disturbed by faulting and folding. The stratigraphy is thus extremely complicated. They are also slightly metamorphosed. The general structural trend of the Older Series is WNW-ESE, which is

limestones and some clastic sediments are also found in the southern part. These rocks range from Oligocene to Pliocene. The northern outcrops are relatively undisturbed, dipping at angles of around 4° to the north. The southern have been disturbed by faulting. The northern Mid-Tertiary limestone belt has given rise to rather spectacular karst topography. Karstic features are not so pronounced in the south.

The Pleistocene is not well represented in Puerto Rico. One or two patches of raised beach or raised reef deposits are found in the west and north coasts. Some poorly defined marine and fluviatile erosional terraces and a series of sand dunes along the north coast are the main representatives of the Pleistocene.

Ledges of recent beachrock are found in many of the beaches.

The older rocks generally are weathered to yellow and reddish saprolitic clays. Depth of weathering may be as much as 15 m and may well exceed this. Consequently the only points where fresh bedrock may be seen are in quarries, roadcuts and in the upper parts of stream valleys. Weathering is rapid. Fresh roadcuts made twenty years ago are now weathered to the extent that fresh samples cannot be collected by normal means (i.e. a hammer).

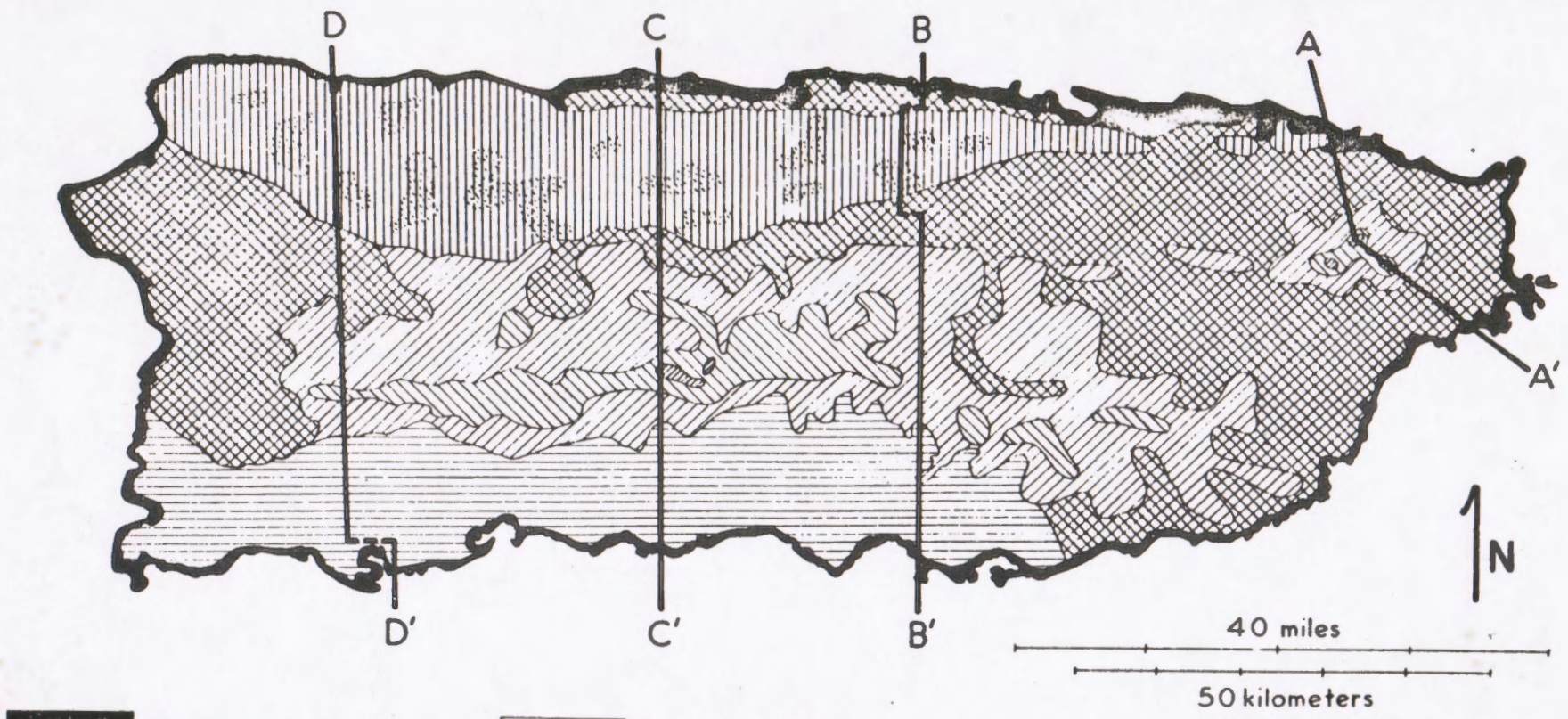

FIGURE 2

Vegetation zones of Puerto Rico, generalized and extrapolated from physiographic and climatic features

Danserau, 1966.

Vegetation

For the most part the island is densely vegetated. However, according to Dansereau (1966) "... the plant cover is now entirely controlled by man. There is no such thing as virgin vegetation, whether forest, savanna, scrub or grassland. The various forest reserves (some of which are not really or mostly forested), however contain stands that have never been actually clear cut and/or have been free of serious interference for a long enough time to convey to the contemporary observer some idea of their original composition and quite possibly of their primeral structure as well."

Contrary to Dansereau's conviction it is now believed that there may be several small areas where the vegetation is virgin, although with such high population densities, there is little likelihood of any area being completely "untouched by man".

According to Woodbury (personal communication) the following tropical formations as defined by Beard, 1955 are found in Puerto Rico:

	Geographic Distribution
A. Tropical Rain Forest	Canovanas - sole remaining example
B. Montane formations	
1. Lower montane (Rain Forest)	Central Cordillera - Maricao to Cayey
2. Palm brake	
3. Elfin	
4. Semi-savanna	Only Luquillo Mountains (East Peak Road)
C. Seasonal formations	
1. Evergreen seasonal forest	Moist limestone hills - north coast

2. Semi evergreen	ditto plus southern slope Central Cordillera and Cabo Rojo-Lajas limestone hills
3. Deciduous 4. Thorn woodland	Southwestern Puerto Rico
5. Cactus scrub 6. Desert	Western part of S.W. Puerto Rico

D. Dry Evergreen formations

1. Dry Rain Forest	Dorado
2. Dry Evergreen Forest	
3. Evergreen woodland and littoral woodland	Beaches on north coast
4. Littoral woodland and littoral thicket	
5. Evergreen bushland and littoral hedge	
6. Rock pavement vegetation	S.W. Puerto Rico

E. Seasonal Swamp formations

1. Seasonal swamp forest	North-central and east coast
2. Seasonal swamp woodland	
3. Seasonal swamp thicket	North coast
4. Savanna	

F. Swamp formations

1. Swamp forest and mangroves	Coastal areas
2. Swamp woodland	Coastal areas, mainly north and east
3. Swamp thicket	Only Tortuguero
4. Herbaceous swamp	North and east coasts

Wildlife

The most important groups in the terrestrial fauna are reptiles, amphibians, birds and insects. Indigenous mammals are only represented by about ten species of bats. The reptilian fauna is represented largely by lizards and one or two snakes including the Puerto Rican boa; amphibians by frogs and toads. A number of species are endmic to Puerto Rico and many are endangered. The marine fauna and flora is very rich; corals sponges, mollusca, and fish abound. Turtles are found in the surrounding waters and nest in beaches of Puerto Rico and offshore islands. The West Indian Manatee is rare and endangered. Several rare species of whale pass in the vicinity of the islands.

Regional Themes

The regional themes decided upon for the compilation of this inventory were:

1. Coastal Geology and Ecology

   (a) Seashores, islands
   (b) Coral islands, reefs
   (c) Estuaries, lagoons, luminescent bays
   (d) Marine environment

2. Terrestrial Geology and Ecology

   (a) Plains, plateaus
   (b) Cuestas
   (c) Mountain systems
   (d) Works of igneous activity
   (e) Hot water phenomena
   (f) Eolian landforms
   (g) River systems and lakes
   (h) Karstic phenomena
   (i) Pre-Cretaceous to Eocene geologic history
   (j) Oligocene to Recent
   (k) Tropical Ecosystems
   (l) Semi-arid ecosystems
   (m) Karstic and underground ecosystems

From what has been stated earlier in regard to the population density and the almost complete lack of original or primeval vegetation it would seem that nowhere in the island would there be any location that could satisfy the integrity requirements to qualify as a natural landmark. However, it is suggested that this requirement should perhaps be interpreted as flexibly as possible in connection with those sites included in the inventory, particularly those given the highest priority.

Particularly unique from the national standpoint is the northern tropical karst belt, the Luminescent Bay at La Parguera and the limestone islands of Mona and Monito.

It must also be borne in mind that much of the plant life and indeed of the wildlife generally while not unique to Puerto Rico, being found in other West Indian islands, is nevertheless not found elsewhere in United States territory.

General References

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Warmke, G.L. & R.T. Abbott, 1961. Caribbean Sea Shells. Livingston Publishing Co., 346 pp.

Priority Rating

The National Park Service has developed a priority rating system to be used as part of the site selection process. The system which follows will be used in this report.

Priority 1. High degree of national significance, recommended without reservation.

Priority 2. Definitely eligible and recommended, but not quite as good as priority 1.

Priority 3. A good site, but not quite nationally significant.

Priority 4. Not recommended.

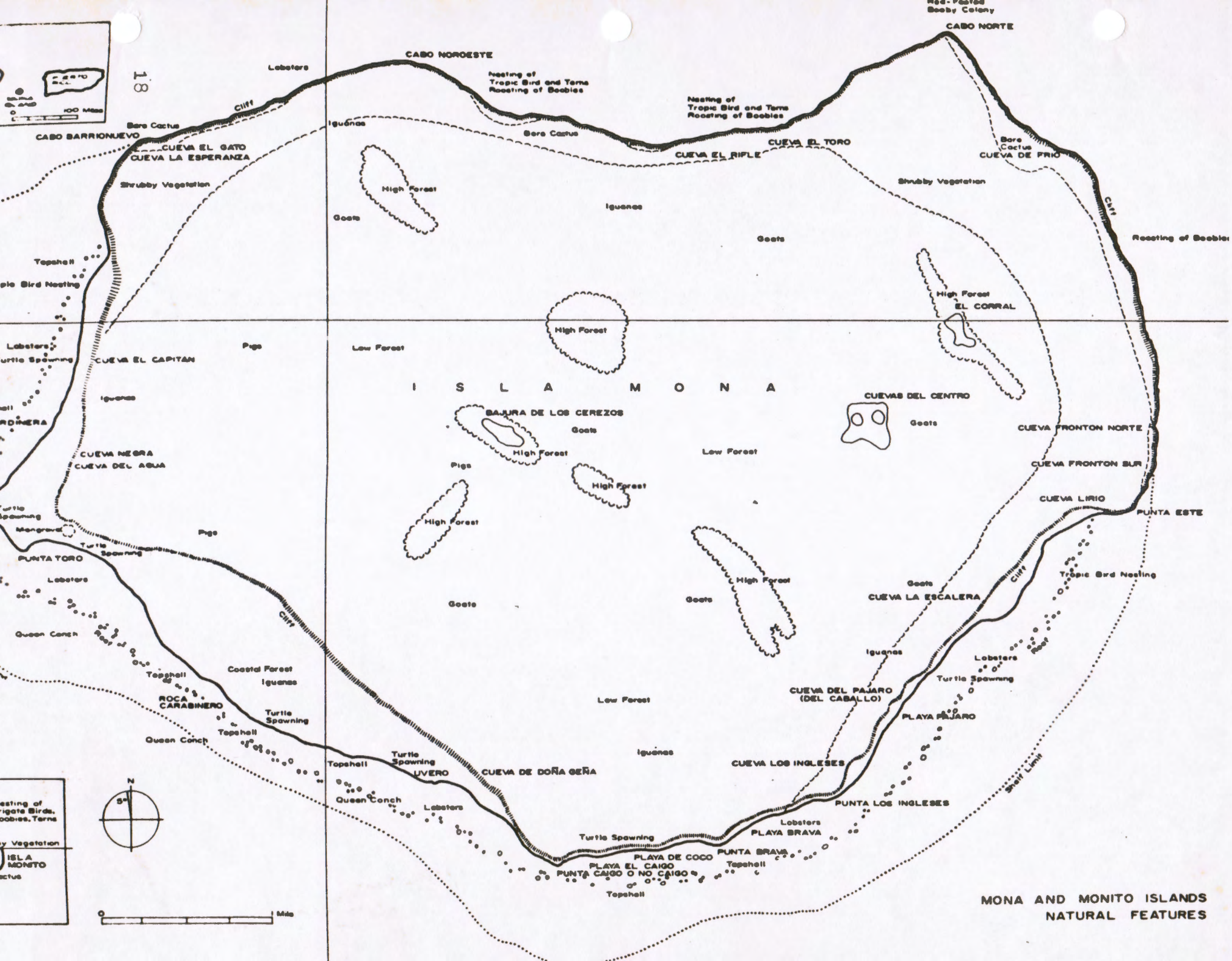
Additionally, letters are used with the priority numbers to indicate the relative impending danger to the sites. They are:

A Site in serious impending danger.

B Site in some jeopardy.

C Site in no apparent danger.

D Relative jeopardy unkown.



MONA AND MONITO ISLANDS
NATURAL FEATURES

Area Designation: Mona and Monito Islands (Now an approved natural landmark)

Location: Mona - 18°03'-18°08'N, 67°51'-67°57'W
Monito - 18°10'N, 67°57'W

Size: Mona - 54.5 sq. km.
Monito - .16 sq. km.

Ownership: Commonwealth of Puerto Rico

Current Land Use: Recreational - hunting, fishing. The area is relatively undisturbed, with no permanent settlement. Mona can be reached by boat or light plane; Monito may be approached by boat but landing is extremely hazardous.

Description of Natural Values

Geology

Mona is a limestone island with a very flat upland surface ranging from 90 m. elevation in the northeast to about 30 m. in the south with a maximum relief of about 40 m. It is bounded by steep cliffs descending to a coastal lowland in the western, southwestern and southeastern parts.

The bulk of the island is composed of the Isla de Mona Dolomite (about 3% $MgCaCO_3$) which is of early or middle Miocene age. The Liria Limestone, a pure limestone, overlies this with a gradational contact. It is also of Miocene Age. Along the southern and western coasts, Pleistocene Raised Reefs are found at elevations from 2 to 10 m. In the southwest they form an extensive flat area. There are numerous caves, the deepest of which penetrated about 240 m. from the cliffs. The caves all contain deposits of phosphorite, derived from bat guano which was worked at intervals until 1924.

Water resources are meager.

Coastal Ecology

Due to the isolation of this island the pelagic environment is close at hand. Whales and large fish are seen close to shore. Boobies, terns and frigate birds nest on the islands and their is a rookery on Monito which includes the bluefaced booby. This species is extremely rare in the eastern Caribbean and is known to nest only on Monito and one small cay off the western end of St. Thomas, Virgin Islands. Many migratory forms, fish, whales and birds are seen at various seasons.

On the north submarine cliffs descend vertically to depths of up to 30 m. and on their face grow large sponges, coral and algae. There are also many varieties of fish - ocean surgeon fish, red snapper, groupers, giant parrotfish, barracuda. Turtles are also found here.

On the southwest the shelf breaks at about 15 m. a hundred meters from shore, with a sheer drop to great depth. Sponges and corals flourish and fish are abundant. In the northwest of Mona a barrier reef forms a shallow lagoon coral habitat.

The white beaches, amongst other things form nesting place for turtles. Five species are known but are now rare and endangered.

Fish species exceed 270; 40 species of marine mollusc; 50 species of macro algae are known.

Owing to its location and lack of surface drainage Mona clearly contains a diversity of coastal habitats. The water is much clearer than around neighboring Puerto Rico, supporting a large variety of thriving reefal fish communities; coral reefs are very well developed and several types can be seen in a relatively small area.

Terrestrial Ecology

Vegetation. More than 600 spermatophytes and about 50 tree species are known; 4 plant species are found nowhere else in the world. Three species of mosses include one endemic to the island; of 15 species of fungi, 7 are endemic.

Invertebrates. Three species of crustaceans include the hermit crab which migrate to the beaches in thousands in August to release their larvae in the sea. Sixteen species of land snails are known, four endemic. There are 53 known species of spider, 9 of which are unknown elsewhere, three species of scorpions and four of centipides. Out of 500 species of insects, 24 are found only in Mona.

Vertebrates. One amphibian, the Mona coqui, is found nowhere else. Four of the six species of lizard are not found elsewhere.

The large Mona ground iguana is unique to Mona. The presence of goats and pigs appears to be endangering it.

Out of 100 species of birds, two are unknown elsewhere and others are rare or endangered.

Large numbers of goats, pigs and some cats are introduced.

Area Integrity Danger

The island is at present visited chiefly by those interested in hunting, fishing, and camping, as well as by students of natural history. Marked increase in uncontrolled hunting and fishing in the future would be likely to endanger the environment. A proposed plan to establish a superport and refinery on the island could hardly fail to destroy much if not all the unique natural conditions.

Eligibility for Landmark Status

These islands are clearly of unique national significance being perhaps the only uninhabited area in the Greater Antilles. Particular emphasis is placed on these themes. 1. Seashore, islands. 2. Coral islands, reefs. 3. Lagoons. 4. Marine environments. 5. Karstic phenomena. 6. Semi-arid ecosystems.

Owing to its position in the middle of the Mona Passage it is one of the very few places where pelagic and shallow water environments are closely contiguous.

Its isolation also renders it an ideal place for the study of speciation by geographic separation.

Published Reference

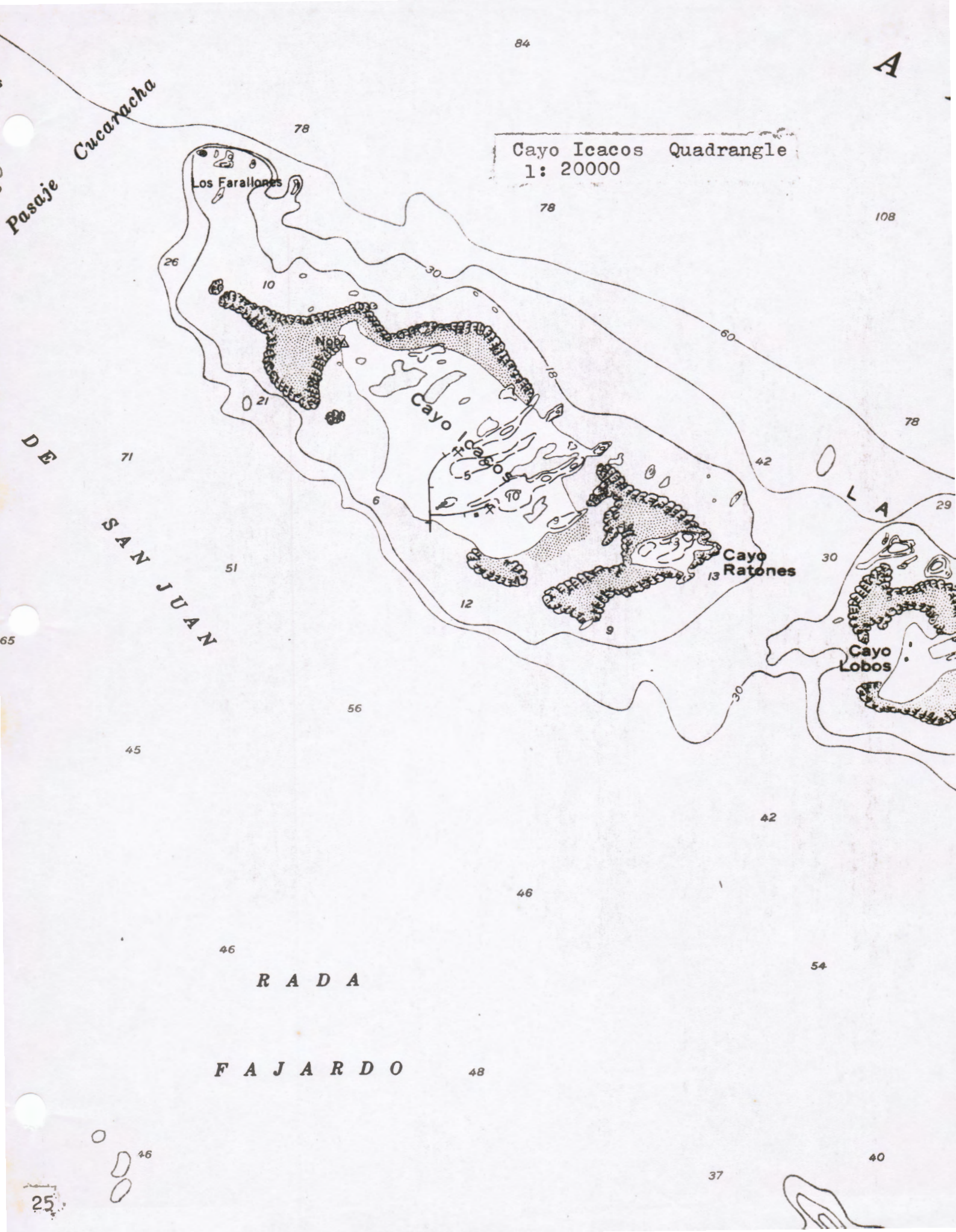
Las Islas de Mona y Monito. Una evaluacion de sus Recursos Naturales e Historicos: 1972. E.L.A. de Puerto Rico, Junta de Calidad Ambiental. 2 vols. (Vol. 2 contains a full bibliography).

Comments

Mona and Monito Islands were designated as an approved natural landmark by the Secretary of the Interior on May 15, 1975. The above description is included so that the inventory of significant natural areas in Puerto Rico is complete.

Culebra & Adjacent Islands
1: 30000
Pta de Molinos
Pta Flamenco
Bahía Flamenco
Playa Flamenco
Laguna del Flamenco
Pta Tamarindo Grande
Pta Tamarindo
Bahía Tamarindo
Canal de Luis Peña
Cayo Yerba
Las Hermanas
Cayo Ratón
Cayo del Agua
Punta Cruz
Punta Melones
Bahía de Sardinas
Pta Tampico
Punta de Maguey

Culebra Island and Adjacent Cays


Cayo Icacos Quadrangle
1: 20000
Pasaje Cucaracha
Los Farallones
Nota
Cayo Icacos
Cayo Ratones
Cayo Lobos
DE SAN JUAN
RADA
FAJARDO
84
78
108
26
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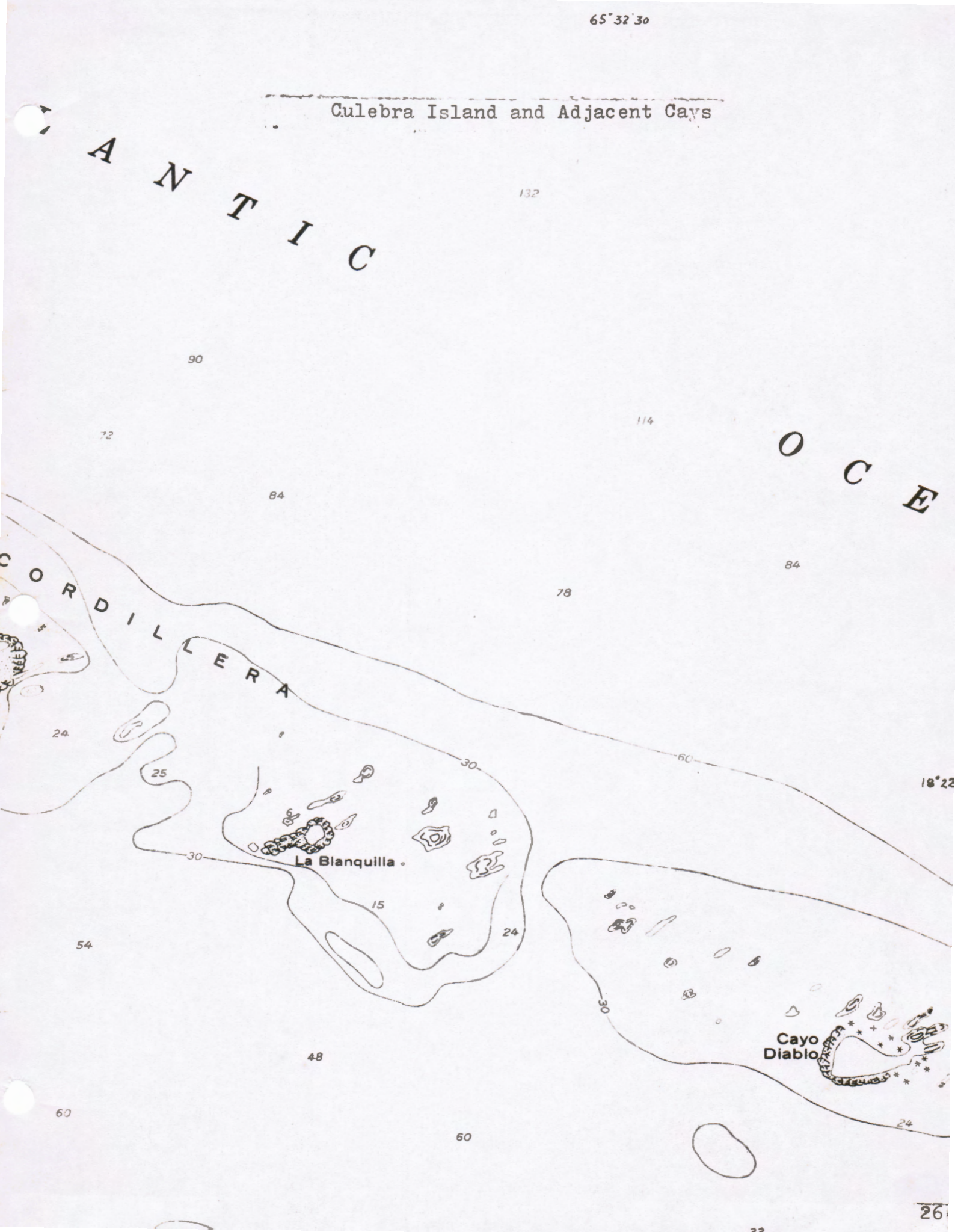
65°32'30

Culebra Island and Adjacent Cays



Area Designation: Culebra Island, Island of Culebrita and adjacent Keys. La Cordillera including Cayo Icacos. 1D

Location: Culebra - 18°18'N, 65°18'W
La Cordillera - 18°25'N, 65°35'W
Culebra and Adjacent Islands and Cayo Icacos quadrangle (1:20,000)

Size: Culebra - approximately 26.0 sq. kms. Keys and other islands - approximately .2 sq. kms.

Ownership: Parts of the former Naval Defense area are owned by absentee landlords. Most of the Keys and La Cordillera are owned by the Commonwealth of Puerto Rico. Several small Keys in the vicinity of Culebra are privately owned (Cayo norte, etc.).

Current Land Use: Culebra - Culebrita and adjacent Keys - Naval training and gunnery; on holidays - fishing recreation. La Cordillera - recreational, fishing, limestone quarry.

Description of Natural Values

Geology

Culebra and adjacent Keys are underlain by volcanic and intrusive rocks of probably Upper Cretaceous age. Andesite lavas and tuffs are particularly well exposed in the Naval Defense area. Diorite intrusions are found in north-Central Culebra and diorite porphyry on Cayo de Luis Pena. Alluvial deposits include fine coral sands with coarse gravels in beach deposits and fine sand and clays underlying mangrove swamps and several lagoons.

Three geological localities appear to have considerable value.

1. Layered tuff deposited on pillow lava - exposed on road cut to the U.S. Navy observation point.
2. Thick beds of tuff showing spheroidal weathering - exposed on sea cliff east of Playa Bravo.

3. Large exposure of pillow lava on Punta Seria, Cayo Norte. La Cordillera appears to be composed mainly of eolianite dunes and skeletal sands. On Cayo Icacos a unique oolitic dune has been described. Similar deposits are found only in the Bahamas and Florida.

Water resources are meager. No commercially valuable mineral deposits are found.

Coastal and Marine Ecology

Because of its location and low topography the island is relatively dry. As a result, no flowing rivers enter the coastal waters, which remain very clear, permitting lush development of a variety of coral reefs. The lack of terrestrially-derived muds also helps development of flourishing non reefal communities. Clean, white, mainly fine-grained calcareous sand beaches develop behind the reefs and between rocky promontories.

Pelagic and reefal fish are abundant. Because of the sparse human population, lack of industrial development and the former existence of naval maneuvers the area has not been heavily fished and has concentrations of fish, lobsters, octopus, queen conchs and helmet shells higher than Puerto Rico. The small keys and the reefs of La Cordillera support undisturbed coral communities with abundant marine organisms.

A variety of littoral communities, most quite undisturbed can be easily observed in a relatively small area. Several of the beaches on Culebra provide nesting grounds for Hawksbill and loggerhead turtles. Whether nesting is occasional or repetitive is

not known as no tagging studies have been made.

Terrestrial Ecology

Culebra supports flora mainly of the seasonal formations (c) and seasonal swamp formations (e). About 370 species of indigenous plants are found including 111 tree species, 104 weedy species, 10 epiphytes, and 4 parasites. Thirty-three of those species are rare or unique to Culebra and adjacent islands. Of these, 3 are found only in Culebra. The cactus scrub association produces 7 species of cacti, including 2 rare ones. The palm forest is unique, found only on a few neighboring islands east of Culebra.

At Monte Resaca an unusual park-like open forest exists. In several areas of the northern coast a unique association based on tall fan-leaved palm (Cocothrinax argentea) is found.

The avifauna is very rich, composed of at least 70 species. Three of those are rare and endangered (Geotrygon mystracea, Columba lencocephala, Phoenicopteriss ruber). The marsh ponds, mangroves swamps and adjacent Keys provide large nesting and wintering grounds.

Several lizards, 2 species of snakes and 2 species of turtles are found. Bats, rats, mice andintroduced white-tail deer are also present.

Area Integrity Danger

The area of Culebra formerly belonging to the Navy was continuously shelled. Explosions of shells in the coastal waters have destroyed reefs and caused removal of hard substrates, as well as increase in turbidity. Uncontrolled human activities may cause overfishing and induce pollutants. La Cordillera is in danger of overfishing by tourists. Local reefs are used for supply of coral

heads for souvenir marketing. It is understood that some interests have been buying up land for development of tourist hotels. This would probably destroy the integrity of the area completely.

Eligibility for Landmark Status

The Island of Culebra, adjacent Keys and La Cordillera comprise a relatively undisturbed area rich in contrasting but closely spaced environments. Particular emphasis is placed on these themes: 1. Seashores, islands. 2. Coral islands, reefs, 3. Lagoons. 4. Marine environments. 5. Semi-arid ecosystems. 6. Geologic phenomena.

Recommendations

The Navy has now removed the Naval Defense Sea Area. To discourage the urbanization and industrialization of this unique area, the island of Culebra adjacent Keys and La Cordillera should be included in the Registry of Natural Landmarks.

Published References

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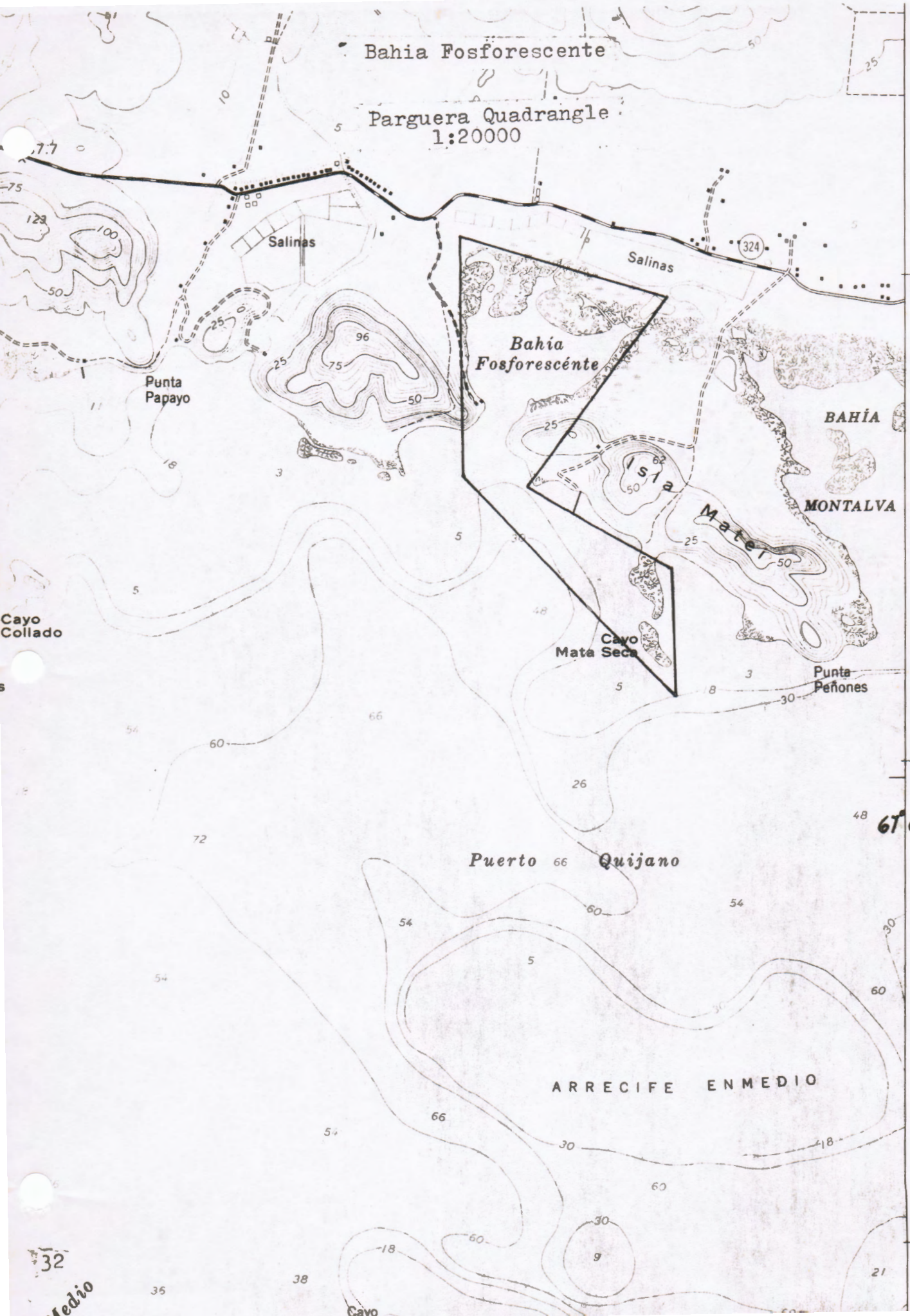
4. Kaye, Clifford A., 1959. Shoreline Features and Quaternary shoreline changes, Puerto Rico. U.S. Geol. Surv., Prof. Paper 317-B, p. 49-39.

Data Source: Dr. N. Schneidermann

Note: The Navy has withdrawn from Culebra as of September 1, 1975. The Commonwealth Government is to set up a commission to oversee the development of the island and prevent damage to its natural values.

Other Knowledgeable Persons: Dr. Roy Woodbury


Bahia Fosforescente
Parguera Quadrangle
1:20000
Salinas
Salinas
324
16 000
METERS
Bahía
Fosforescénte
Punta
Papayo
BAHÍA
MONTALVA
Isla
Matel
Cayo
Collado
Cayo
Mata Seca
Punta
Peñones
17°
57'30"
67°00'
Puerto
Quijano
ARRECIFE ENMEDIO
Cayo

Area Designation: Bahia Fosforescente. 1B

Location: East of La Parguera (approx. 17°58'N-67°01'W Parguera quadrangle (1:20,000)

Size: Bay - .25 sq. kms.
Mangroves around it - .22 sq. kms.
Mud flats - .27 sq. kms.

Ownership: Commonwealth of Puerto Rico, the Conservation Trust, private.

Current Land Use: Recreational - tourism, fishing. Disposal site of brines from adjacent salt pans.

Description of Natural Values

Bahia Fosforescente is a small bay, connected by a narrow and shallow entrance to the sea. A shoal and fringing coral reef add to its protection from open sea waves. The bay is subdivided into a central lagoon having the maximum depth of about 3.5 meters and surrounding mangrove lined channels. Tidal flats, commercially utilized as salt pans, extend beyond the mangroves. The area receives very little rainfall. The bay is surrounded by hills composed of steeply dipping Cretaceous La Parguera Limestone.

Marine Ecology

The bay supports permanent concentrations of the bioluminescent dinoflagellate Pyrodinium bahamense. As a result, year round bioluminescence is observed. This dinoflagellte emits light when disturbed and hence particularly on moonless nights the movement of fish, the wake of a boat or any other disturbance of the water causes brilliant patches of luminescence. In addition, normal marine flora and fauna is found.

Area Integrity Danger

Bahia Fosforescente is presently one of the major tourist

attractions on the southern coast. In addition, the bay is used by local fisherman and also as a dumping ground for heavy brine concentrated in the salt pans. It is not clear whether the brine pollution and heavy boat traffic endanger the population of Pyrodinium.

Recent studies of circulation patterns in the bay have shown that dinoflagellates are concentrated in the bay from the shelf waters. The bay is downcurrent from heavy pollution created by petroleum industry in Bahia Guanilla, and there is a constant danger that the pollutants may be concentrated in the bay.

Eligibility for Landmark Status

Bahia Fosforescente is one of the very few bays in the world having a continuous display of bioluminescence. Themes emphasized: 1. Seashore. 2. Coral reefs. 3. Marine environment. 4. Mangroves.

Recommendations

Bahia Fosforescente should be given the highest priority for inclusion in the Registry of Natural Landmarks.

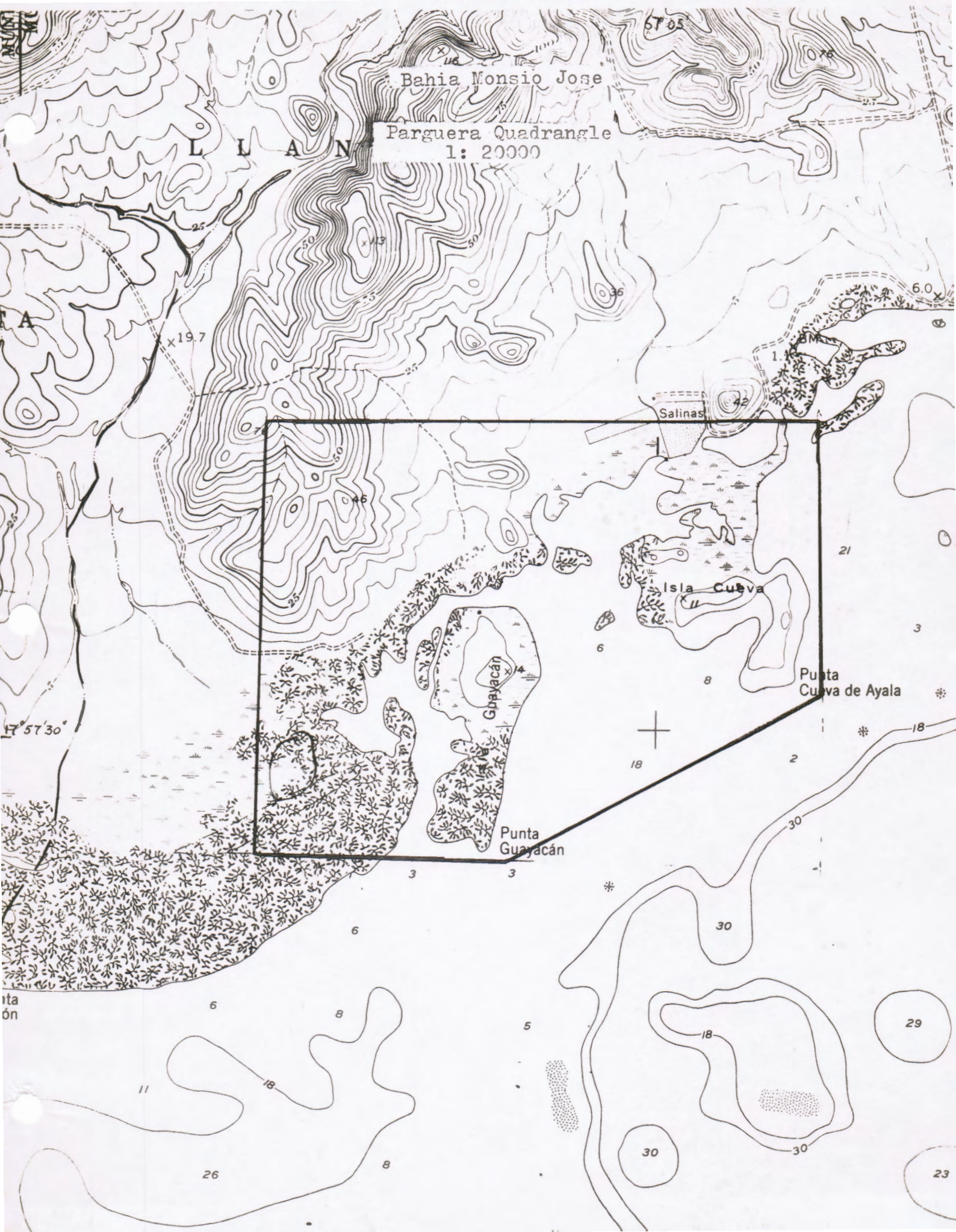
References

1968. The Bioluminescent Bays of Puerto Rico. U.S. Dept. of Interior, National Park Service.

It should be noted that it has been suggested that this site should be made a National Park but so far no steps have been taken to implement this.

Data Source: Dr. N. Schneidermann

Other Knowledgeable Persons: Dr. Juan G. Gonzalez


Bahia Monsio Jose
Parguera Quadrangle
1: 20000
Salinas
Isla Cueva
Punta
Cueva de Ayala
Guayacán
Punta
Guayacán

Area Designation: Bahia Monsio Jose 2A

Location: $17^{0}57'31"N - 67^{0}05'00"W$
Parguera quadrangle (1:20,000)

Size: 4 sq. kms. Bay - 40 acres

Ownership: Commonwealth of Puerto Rico

Current Land Use: Nil. Some clamming and hunting is done in the mangrove swamps

Description of Natural Values

This, the smallest of the three luminescent bays of Puerto Rico is situated about 4 kms. east of La Parguera. The headlands enclosing the bay are underlain by Ponce limestone (Miocene). It is backed by salt flats with salinas.

The northern part of the bay supports periodic displays of bioluminescence but these have deteriorated in recent years. This is believed to be due to the effects of a canal cut through the mangrove on the neck joining Isla Cueva to the mainland. This was done for the purpose of confining monkeys on the island for the purposes of a National Institute of Health research project. The southern half of the bay itself is now completely filled with mangrove.

To the westward of Isla Guayacan canals through the mangroves lead to a small lagoon at about .75 km. distance. This lagoon supports a permanent and strong concentration of the dinoflagellate Pyrodinuim bahamense which causes the luminescence.

Area Integrity Danger

Bahia Monsio Jose itself has apparently already been affected by the construction ofthe barrier. The small lagoon west of Isla Guayacan appears to be unaffected and is likely to remain so.

Eligibity of Natural Landmark Status

The area, being one of the three areas of bioluminescence in Puerto Rico is unique and is eligible for Natural Landmark Status. Owning to the smallness of the locality of permanent luminescence it is only given priority 2.

Recommendations

The area most certainly should be given consideration for landmark status but it is felt that Bahia Fosforescente and Puerto Mosquito should have higher priority.

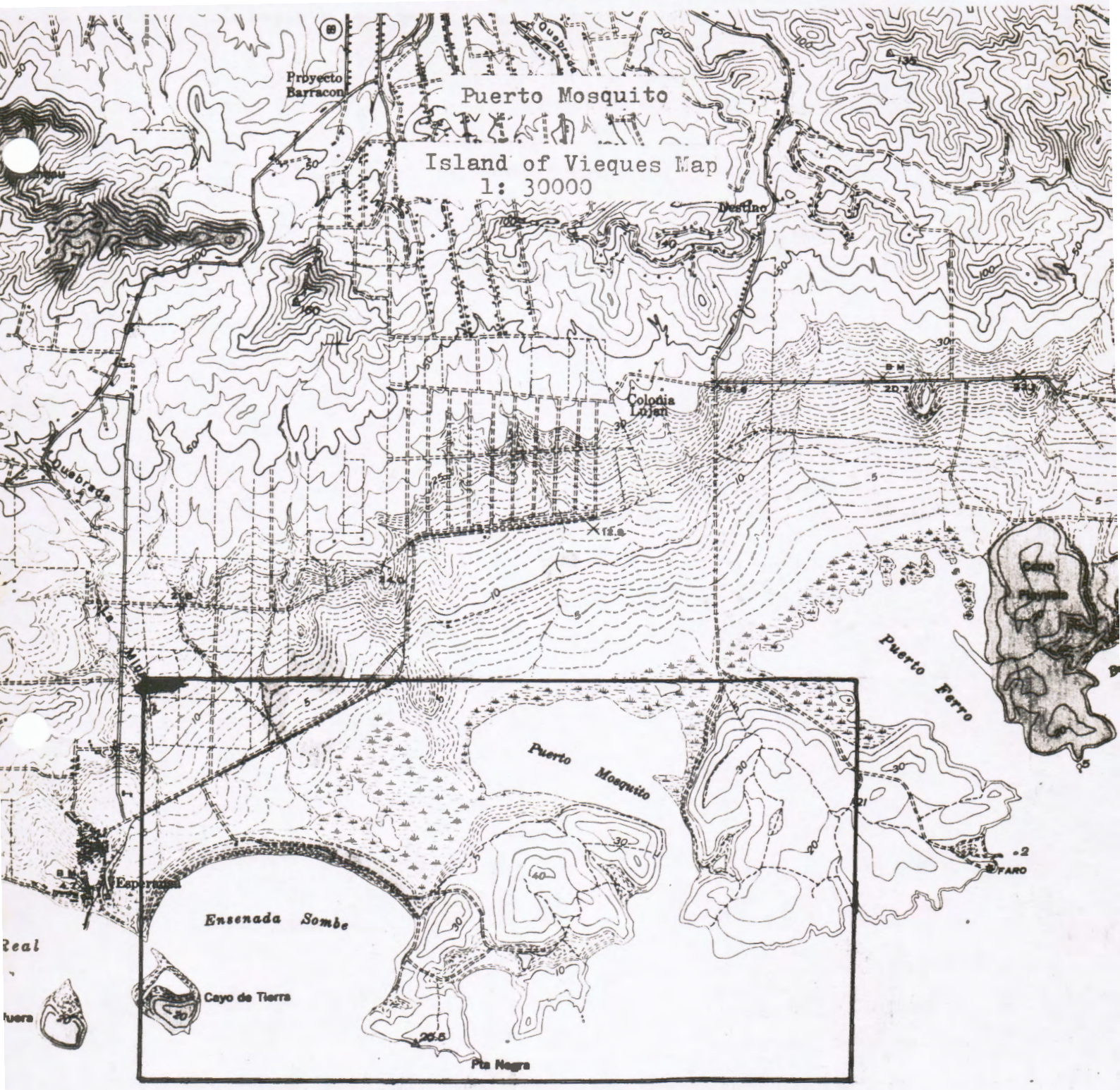
Themes emphasized: Mangroves, luminescent bays.

References

1968. Bioluminescent Bays of Puerto Rico. U.S. Department of Interior. National Parks Service.

Data Source: Above reference and Mr. C. Cutress

Other knowledgeable persons: Dr. Juan Gonzalez


Puerto Mosquito
Island of Vieques Map
1: 30000
Proyecto Barracon
Destino
Colonia Lujan
Quebrada
Puerto Ferro
Puerto Mosquito
Ensenada Sombe
Cayo de Tierra
Pta Negra
FARO
Esperanza
Real
18°05'
B E A N
S E A

Area Designation: Puerto Mosquito, Vieques Island 1C

Location: 18°05'30"N - 65°21'30"W
(Island of Vieques Map: 1:30,000)

Size: 7 sq. kms.

Ownership: Private

Current Land Use: Some grazing to northward

Description of Natural Values

Scenic

The bay is a deep inlet in the cliffed southern coast of Vieques island. The sea bottom falls off steeply and there is only small development of reefs. The bay itself is lined with red mangroves and is backed by a natural salt flat which has not been modified into a commercial salina.

Behind the flat the low hills support an open savanna vegetation dominated by thorny acacia and maran.

Geologic

The two headlands to east and west of the bay are composed of Puerto Ferro limestone of Tertiary (probably Miocene) age. To the northwest a very small area of granodioritic rocks emerges from under the limestones. To the north behind the bay is a natural salt flat.

Marine Ecology

The most important element of the fauna that gives the bay uniqueness is the high permanent concentrations of dinoflagellates, in particular the luminescent Pyrodinium bahamanse. The bay is one of the three luminescent bays in Puerto Rico, and contains concentrations as high as 40 per milliter in its northeastern

part as compared to a maximum of 8 per millimeter in Bahia Fosforescente. (Seliger, et al, 1969). The concentrations do vary but nevertheless these luminescent bays are unique; the only known example in this region that has displayed higher concentration is Oyster Bay in Jamaica (150 per millimeter) which is understood to have been degraded by pollution.

The Bay also contains normal marine flora and fauna, but coral development is very small since the bottom falls off very steeply seaward.

Area Integrity Danger

At present there does not appear to be any danger to integrity.

Eligibility for Landmark Status

The unique bioluminescent display and in particular the high concentration compared with other such bays in Puerto Rico renders it eligible for landmark status.

Recommendations

Puerto Mosquito should be given first priority.

Themes emphasized: Seashore, marine environment, mangroves, luminescent bays.

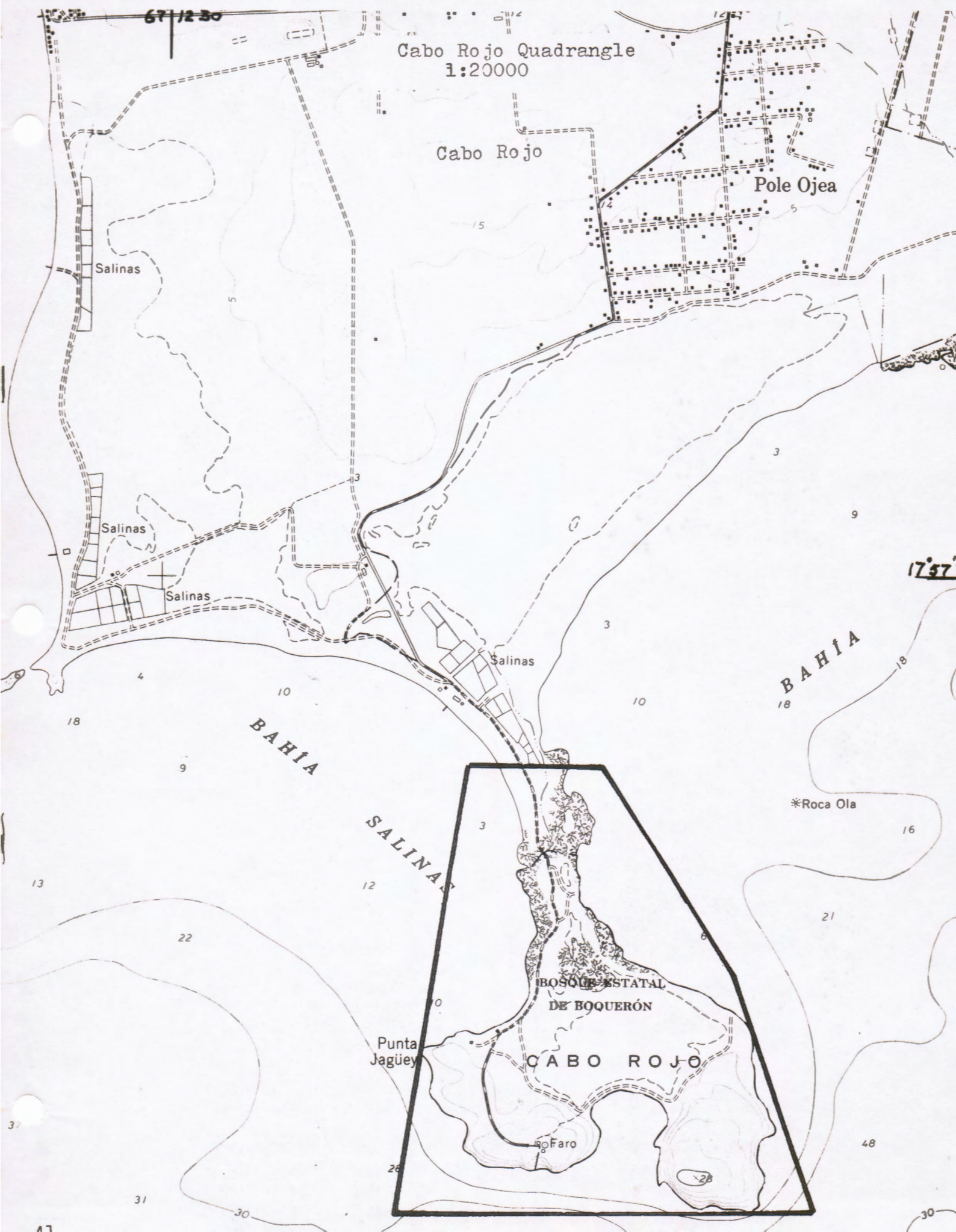
References

1968, Bioluminescent Bays of Puerto Rico. U.S. Dept. of Interior, National Park Service.

Seliger, H.H., W.G. Fastie and W.D. McElroy, 1969. Towable Photometer for Rapid Area Mapping of Concentrations of Bioluminescent Marine Dinoflagellates. Limnology and Oceanography, v. 14, p. 806-813.

Data Source: above references

Other knowledgeable person: Dr. Juan Gonzalez


67 12 30
Cabo Rojo Quadrangle
1:20000
Cabo Rojo
Pole Ojea
Salinas
Salinas
Salinas
Salinas
BAHIA
SALINAS
BAHIA
Roca Ola
BOSQUE ESTATAL
DE BOQUERÓN
CABO ROJO
Punta
Jagüey
Faro
17°57'

Area Designation: Cabo Rojo. 25

Location: SW point of Puerto Rico; approximately 17°56'N-67°11'W. Cabo Rojo quadrangle (1:20,000)

Size: Approximately .75 sq. kms.

Ownership: Commonwealth of Puerto Rico

Current Land Use: Recreational - lighthouse

Description of Natural Values

Geology

This site is a tied island, or tombolo. It is actually two islets composed of Miocene Ponce limestone which are joined to the mainland by a sandspit about 1 km. in length which is Y-shaped. The islands are joined by another spit which with the two limbs of the Y enclose a salt water lagoon. The islands are about 20 m in elevation and present steep cliffs to the south. Salinas or commercial salt ponds are operated on the landward end of the main spit. A lighthouse is situated on the western islet. The site is interesting in the rather unique form of the connecting spits.

Ecology

The vegetation is of the degraded coastal type (seasonal formation 4, 5, 6). The western island has been completely damaged but the eastern island still preserves typical savanna type vegetation with the grass Uniola variegata and a rare orchid Tetramia elegans; cactus and thornbrush. Rainfall is about 76 cm.

Near El Faro there are small breeding colonies of least terns and the only known colony of money plovers. Other breeders include black necked stilt, Wilson's plover, yellow shouldered

blackbird and possibly some herons.

Area Integrity Danger

The beach dividing the two islets is moderately popular with weekend holiday makers but it is not thought that there is any great danger involved. The National Park Service 1968 report recommends development of the area near Cabo Rojo for recreational purposes in order to divert such activities from La Parguera.

Recommendations

This site is rather unique in the form of the spits but it is doubtful if it is of high national significance.

Themes emphasized: islands, seashores, semi-arid ecosystem (savanna type).

Reference:

1968, The Bioluminescent Bays of Puerto Rico: National Park Service.

Data Source: Personal observation
Dr. Roy Woodbury
Dr. D. Wilson

Other Knowledgeable Persons: none known

Vega Alta Quadrangle
1:20000
C E I B A
Barrio Almirante
Comunidad Ceiba
Monserrate
RÍO ABAJO
Río Indio
Río
CIBUCO
(MANATÍ)
Cerro Miraflores
BM
ALMIRANTE NORTE
BAJURA
Escuela Almirante Norte
Cibuco
4.6
4.0
5.3
8.0
10.4
7.9
8.5
9.4
13.3
70.7
25'

Area Designation: Isolated Mogotes in Barrio Almirante Norte, Vega Baja, Puerto Rico. 1C

Location: Km. 1.8 of road 160 (from Route 2 to Morovis), on the east side. Approximate coordinates of center of area - Long. 66°22'15", Lat. 18°25'55" Vega Alta quadrangle (1:20,000)

Size: An area of approximately .04 sq. kms. enclosing two small mogotes.

Ownership: The land is owned by the Commonwealth of Puerto Rico and is presently leased to Nutrilite Products Inc.

Current Land Use: The flat karst plain between the mogotes is presently planted with acerolas, a cherry-like fruit which grows on small trees and is a source of vitamin C. The mogotes themselves, however, have not been disturbed or cleared. They still have their natural vegetative cover and have not been modified or developed in any way.

Description of Natural Values

Geology and Geomorphology

Mogotes are haystack shaped residual hills characteristic of tropical karst terrain; that is, they are karst monadnocks. They are the remaining high terrain between numerous, enlarging sinkholes. When the downward solution of the sinkholes reaches local base-level, the sinkholes widen and coalesce to form a flat karst plain with only a few small residual mogotes remaining.

The karst terrain of northern Puerto Rico is a classic example of tropical karst topography. Mogotes are very common features of this terrain. To the north, near the coast, the solution process is most advanced and isolated mogotes protrude above the intervening flat, karst plain. Farther inland, to the south, the process is not as advanced and sinks and mogotes alternate in what has been termed a "lunar landscape". The mogotes under consideration are developed on the Aymamon Limestone.

Area Integrity Danger

The mogotes themselves are not in any immediate danger. The lessee of the land in question is aware that these are geologically interesting features and will probably not disturb them.

Eligibility for Landmark Status

Although the land surrounding these mogotes is cultivated, the mogotes themselves are in their natural state. From this area many more unmodified mogotes can be seen in the surrounding terrain. The area selected is off of the main highway and in rural surroundings. Because of the high population density in Puerto Rico, flat land such as the karst plain will almost always be cultivated or developed in some way. Since the mogotes are the features here recommended and since they are undisturbed, it is felt that these are eligible for landmark status.

Recommendations

The Puerto Rican karst terrain is probably the only area of tropical karst features within the United States or its associated territories. Mogotes are typical and unique features of tropical karst. The mogotes selected here are a good representative of the type, being very advanced in development and presenting a sharp contrast between the flat karst plain and the two remaining hills. These, or other similar, mogotes should be a first priority recommendation for Natural Landmark status.

Themes emphasized: Karstic phenomena, Oligocene to recent geologic history.

Selected References

Monroe, W.H., 1964, The origin and interior structure of mogotes

(abs.). Abstracts of Papers, 20th Int. Geog. Cong., p. 108. Published by Thomas Nelson and Sons, London.

_____, 1968. The karst features of northern Puerto Rico. Nat. Spel. Soc. Bull., v. 30, no. 3, p. 75-86.

Miotke, Franz-Dieter, 1973. The subsidence of the surface between mogotes in Puerto Rico east of Arecibo. Caves and Karst, v. 15, no. 1, p. 2-12.

Data Source: Dr. Barry Beck

Other knowledgeable persons: Mr. Watson H. Monroe

57'30"
A T L A
Quebradillas Quadrangle
1:20000
Cañon. de Guataca
FERROCARRIL
VIA
DEL
T O
T E R
C A
Cerro
Quebra
Planta de Tratam
de Aguas N
GUAJATACA
Sequia
Quebrada
Guajataca
MUNICIPIO DE ISABELA
MUNICIPIO DE QUEBRADILLAS
RIO
Monte
de la Luz
El Centro
103.4
42.9
72.2
105.9

Area Designation:	Cañon de Guajataca (Guajataca Canyon) 1D
Location:	4 kilometers west of Quebradillas, P.R. Lat. 18°29'N, Long. 66°57'-66°58'W. Quebradillas quadrangle (1:20,000)
Size:	Designated area 1.2 sq. kms. in north sector of canyon
Ownership:	Sr. Cesar Otero Quevedo
Current Land Use:	Except for scattered small plantings of bananas, the canyon walls are relatively undisturbed.

Description of Natural Values

Scenic

Guajataca Canyon is one of the very few areas in Puerto Rico that retains the scenic beauty of undisturbed lowland forest and its associated animal life. In the sector designated the canyon floor rises gradually from sea level to about 30 meters above sea level, and the walls rise steeply 60 to 80 meters above the canyon floor.

Ecology

Vegetation. Over 200 tree species in the canyon are part of one of the richest stands of lowland trees known anywhere on the island. The flora includes about 50 rare and endangered plant species. Some 20 plant species are found elsewhere in the tropics but nowhere else in Puerto Rico. About 5 species have been discovered here and nowhere else in the world. Between 20 and 25 plant species in the Guajataca flora are species endemic to the island.

Animals. Like the plants, the animals of the canyon make up a rich fauna with rare species that may have once been widespread in the lowlands but are now restricted here. It is the only place that Sloan's skink, Mabuya sloani, is known to occur in any numbers.

The nearly extinct Puerto Rican toad, Bufo lemur, has been found only twice in the last 20 years, both times in this general region, and it may still find a refuge in the canyon. Two other lizards and a snake species that are becoming rare are known to have populations in this forest. Native birds are abundant, although none of them are restricted to this region.

Geology, Particularly Karst Features

The steep walled canyon of the Rio Guajataca is most probably the result of the collapse of an extensive cave system. The Rio Camuy caverns might be considered a youthful example of this process; the canyon of the Rio Tanama, with its numerous short caves where the river disappears underground, as a middle-aged example; and the Rio Guajataca canyon, with its deep, near vertical walls, as an old-age example of the continuation of this process. The canyon here is cut through the Aymamon Limestone with scattered outcrops of Camuy Limestone at the highest points on its margin.

Excellent examples of limestone ramparts are also displayed along the top of the canyon of the Rio Guajataca. This karst feature is closely related in origin to the well-known mogotes and is described by Monroe (1968, p. 84) as follows: "The slopes rise in steep canyon walls of casehardened limestone 155 meters up from the river. On both sides away from the river the surface then drops from the top of the wall some 25 meters to a plain covered by sandy clay. Rising out of this plain are mogotes that have about the same altitude as the top of the rampart and that also rise about 25 meters above the plain." The canyon under discussion by Monroe is that of the Rio Guajataca.

Area Integrity Danger

Land surrounding the canyon and the canyon floor have intermittently been cleared and cultivated, making inroads on the integrity of the forest. Although many of these lands are returning toward the natural state now, there are no guarantees at present that the canyon will not someday be developed for other uses.

Recommendations

A high priority is given to obtaining Natural Landmark status for this large section of Guajataca Canyon. Additional lands belonging to Sr. Otero and other owners might be added to the designation. Further ecological study is recommended.

Themes emphasized: Karstic phenomena; Tropical ecosystems.

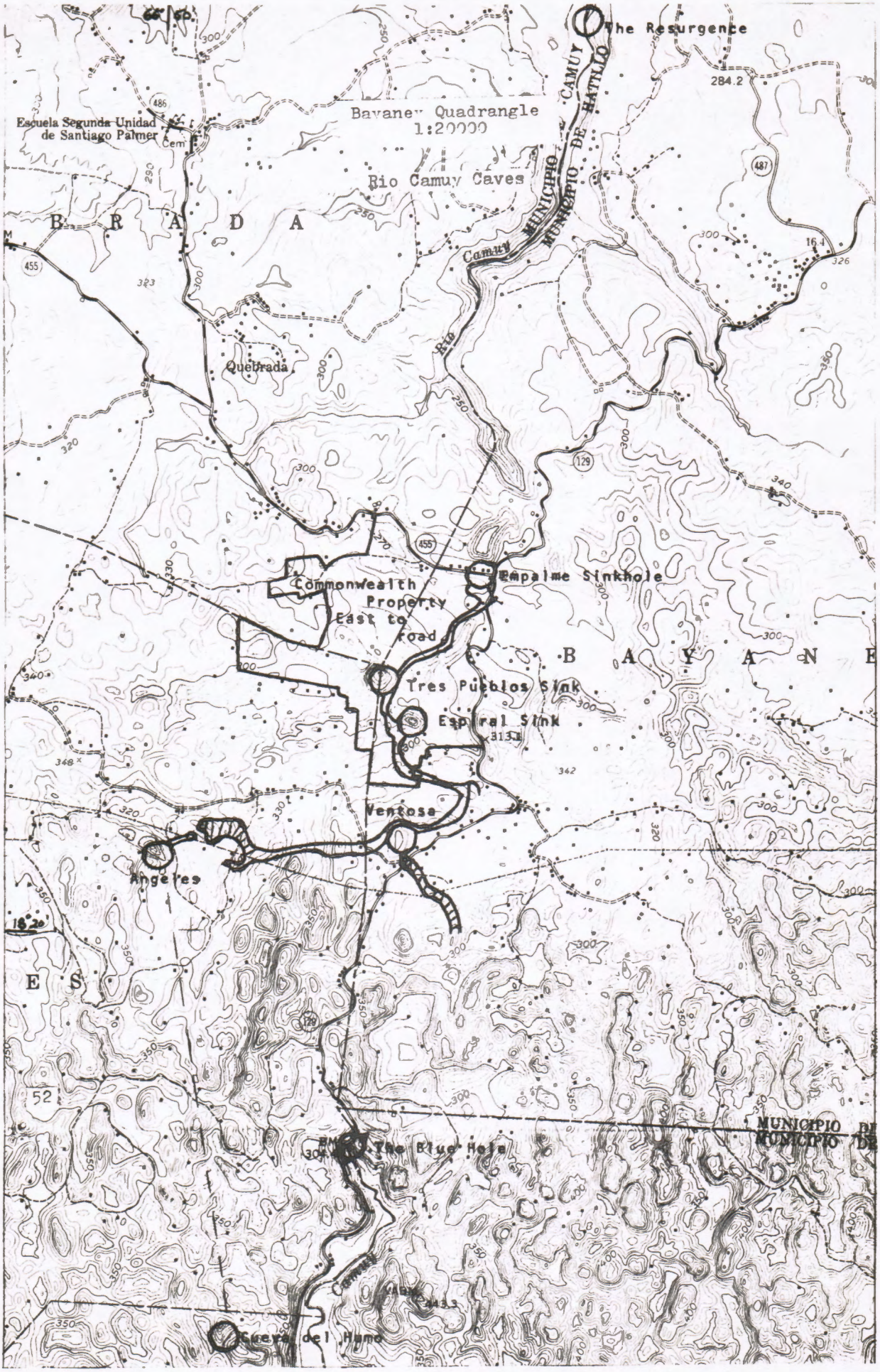
Selected References

Monroe, W.H., 1968. The karst features of northern Puerto Rico: N.S.S. Bull., v. 30, no. 3, p. 75-86.

_____, 1969. The relation of zanjones to caves and rivers in Puerto Rico: Proceedings of the Fifth International Congress of Speleogy, Stuttgart, p. M 36/1-M36/6.

Data Source: Dr. Barry Beck

Other knowledgeable persons: Drs. Roy Woodbury, Manuel Velez, Jr., Juan A. Rivero and Frank Wadsworth


Bayaney Quadrangle
1:20000
The Resurgence
Escuela Segunda Unidad
de Santiago Palmer
Rio Camuy Caves
MUNICIPIO DE CAMUY
MUNICIPIO DE HATILLO
B R A D A
Camuy
Rio
Quebrada
Commonwealth
Property
East to
road
Empalme Sinkhole
B A Y A N E
Tres Pueblos Sink
Espiral Sink
Ventosa
Angeles
E S
The Blue Hole
MUNICIPIO DE
MUNICIPIO DE

Area Designation: The Rio Camuy Cave, particularly the surface features "Blue Hole" and the "Tres Pueblos" sink. 1C

Location: The Rio Camuy cave extends from the Blue Hole (the sinking point) at Lat. 18°19'23", Long. 66°49'32" to the Resurgence at Lat. 18°22'27", Long. 66°49'32". The Tres Pueblos sinkhole is located at Lat. 18°20'40", Long. 66°49'27". Bayaney quadrangle (1:20,000)

Size: The actual cave passage is approximately 7 kms. long and varies in width from approximately 5 m in the canyons of the river to 35 m in the Big Room. The Blue Hole is the name given to the Point where the surface Rio Camuy passes under a vertical wall of limestone and as such has very little area as seen in plan view. The Tres Pueblos sink is circular in plan with a diameter of roughly 200 m.

Ownership: The land surrounding the Blue Hole and the Tres Pueblos sink is owned by the Commonwealth of Puerto Rico. The Rio Camuy Cave, being the course of a river, is also most probably the property of the Commonwealth according to the section of Property Rights of the Civil Code of Law.

Current Land Use: The underground course of the Rio Camuy is unused and totally undisturbed except for a short portion from the Empalme Sink 200 m upstream to where a water supply well intercepts the cave. The land immediately surrounding the Blue Hole is unused, although the land nearby is crudely cultivated. The floor of the Tres Pueblos sink was once cultivated in bananas, but it is no longer reguarly tended. The area immediately surrounding the sink is relatively unused. With in the frame of reference of the island of Puerto Rico (population density 800/sq. mile) this land is relatively undisturbed and unsettled.

Description of Natural Values

Geology, Particularly Speleogy and Hydrology

The surface Rio Camuy flows from the igneous Central Mountains draining an area of approximately 36 km^2. When it reaches the outcrop of the Tertiary Lares Limestone it sinks underground at a cave known

as the Blue Hole which is formed at the head of a deeply incised "blind" canyon with vertical walls circa 50 m tall. At this point the river has a low flow of approximately 15-20 cfs.

From this point the underground Rio Camuy follows a sinuous course for approximately seven kilometers, all parts of which are not accessible. Near the contact of the massive Lares Limestone and the more marly Cibao Formation, the river resurges to again flow on the surface. Here the low flow is on the order of 55 cfs.

Along the course of the Rio Camuy Cave, four karst windows penetrate various depths from the surface to the river. These are, from the upstream end (see map), La Ventosa, Espiral Sink, Tres Pueblos Sink, and The Empalme Sink. The Empalme Sink is the last place at which the river can be seen before it reaches the short cave segment at the resurgence. These last 3-4 kms. of the cave are presently inaccessible. The Tres Pueblos Sink is by far the most outstanding of these karst windows being roughly 200 m in diameter with vertical walls circa 90 m high. It is a sightseeing landmark for planes flying over the area.

The cave itself is impressive for several factors, most notably its dimensions. The Big Room is on the order of 100 m long, up to 35 m wide, and approximately 30 m tall. Massive speleothems occur throughout the cave and the various waterfalls, lakes, and whirlpools are also impressive. The view upward from the various sinkholes, past vertical limestone walls circa 8-100 m tall, to the sky, is awesome.

Ecology

The various tropical forests developed on the mogotes (thicket-

type growth) and in the low areas (tropical mesophytic forest) are probably unique for the United States. The ecologic community of the cave itself consists of numerous tropical bats, tree frogs, toads, rats, and a multitude of as yet uncataloged invertebrates. Limited biological research has already identified a troglobitic isopod known only from specimens taken from the Camuy Caves and a newly reported polydesmoid which has some cave-adapted characters. Numerous other tropical troglophilic invertebrates are also found in the Camuy Caves which would not be found elsewhere in the U.S. outside of Puerto Rico.

Area Integrity Danger

The Caves and immediately associated landforms appear to be in little danger of immediate destruction or modification due to their generally inaccessible nature.

Eligibility for Landmark Status

These relatively uninhabited, unique examples of several tropical karst features on a grand scale are duplicated nowhere else in the U.S.

Themes emphasized: Karstic phenomena, karstic and underground ecosystems.

Recommendations

The Rio Camuy Caves and particularly the Blue Hole and the Tres Pueblos Sinkhole are a primary recommendation for National Natural Landmarks.

Selected References

Gurnes, Jeanne (ed.), 1967. Conservation through commercialization -

Rio Camuy development proposal, Nat. Spel. Soc. Bull., v. 29, no. 2, p. 27-71.

Gurnee, Russell, and Gurnee, Jeanne, 1974. Discovery at the Rio Camuy, New York, Crown Publishers, 183 p.

Data Source: Dr. Barry Beck

Other knowledgeable persons: Mr. Vito Latkovich
Mr. Russell Gurnee

Peñuelas Quadrangle
1:20000
Quebrada de Los Cedros
S A N T O
D O M I N G O
Hacienda Oliva
Peñuelas
Cementerio
LIMITE DEL PUEBLO
Iglesia San Mateo
Quebrada
Subestación
BM 249.8
BM 39.9
Tallaboa Poniente
Tallaboa
C E D R O
U E B A S

Area Designation: The vertical-walled portion of the Quebrada de Los Cedros (Cedros Canyon) and the El Convento Cave System contained therein. 2B

Location: Southwestern Puerto Rico, north of Guayanilla Bay, WSW of Penuelas: Lat. 18°02'52", Long. 66°44'48". Penuelas quadrangle (1:20,000)

Size: The narrow portion of the Quebrada de Los Cedros here under consideration, is approximately 260 m long and 15 to 20 m wide, widening to 110 m at the mouth. The El Convento Cave System which has five entrances within the Quebrada is roughly 600 m long and 10 m wide.

Ownership: Suc. Estela; that is, it is owned jointly by the heirs of the Estela Family. No one person has control. The "major domo" lives in nearby Barrio Magas Arriba and is named Don Rafael Lucas.

Current Land Use: The narrow, vertically walled portion of the Quebrada de Los Cedros is totally unused and unspoiled. Further downstream, where the valley widens, there was formerly a dairy farm based on the spring flow from the El Convento Cave System. In the spring of 1975 this was no longer being used in any way.

Description of Natural Values

Geology, Geomorphology, Speleology

The Quebrada de Los Cedros is a vertically walled limestone canyon, possibly the result of cave collapse, formed in the middle reef limestone unit of the Juana Diaz Formation. Whereas the karst of Puerto Rico's north coast is well documented and considered classic, there are few large-scale karst features on the semi-arid south coast. The El Convento Cave System has pirated a portion of the east flowing surface drainage into a south flowing, subterranean route, which is marked by the narrow Quebrada. The El Convento Cave System, the Quebrada de Los Cedros, and the few associated sinkholes and caves

compose the largest and most impressive aggregate of full-scale karst features to be found on Puerto Rico's south coast.

The walls of the Quebrada are up to 60 m tall and sheer. On the north the longitudinal course of the canyon is interrupted by a 20 m cliff at the base of which are several cave entrances. Just above this cliff a swallow hole absorbs the intermittent flow from the Central Mountains. This reappears in the El Convento Cave, augmented by groundwater, and flows through the cave to emerge at Charco Azul, a perennial third order spring which also marks the widening of the canyon. Between the cliff and Charco Azul there are also two other entrances to the cave system.

The contents of the cave itself are not speleogically unusual. A series of large rimstone dams which completely span the cave cause the river level to drop in a series of steps. Other than these, speleothem development is minor. Cave fauna is restricted to troglophiles and transients carried on the flood flow.

Surface Ecology (Flora)

The Quebrada de Los Cedros combines a number of climatic features which are unusual for its area, thus resulting in an anomolous vegetation. The high vertical walls provide considerable shade and also windprotection. The through flowing stream in the El Convento Cave provides a water source which is absent in most of this semi-arid terrain. On the hills above the gorge the flora is typical, semi-arid, stunted, xerophytic scrub vegetation, the Almacigo tree (Bursera simaruba) being most common.

Cedrela odorata (the Cedro Tree) is the dominant tree in the

gorge and is not found on the dry hills at all. The moist forest understory tree, Dendropanax arboreus is also common. Smaller trees include Amyris elemifera and various species of Ficus. Ferns, coffee, and the herbs Pilea and Urera (Ortiga) are other examples of mesic flora found here. Eugenia rhombea and Clusia rosea grow on the walls of the gorge and their aerial roots intertwine with the lianas. Various epiphytes are also extremely common. All in all, the flora of the Quebrada is in sharp contrast to the normal southwestern Puerto Rican scrub vegetation.

Area Integrity Danger

A sanitary landfill planned by the Municipality of Penuelas for a sinkhole above the Quebrada has high potential for polluting the karst groundwater in the cave. The access roads may also increase human traffic in this area. Other than this, there are no known plans for the Quebrada area.

Eligibility for Landmark Status

The narrow confines of the Quebrada de Los Cedros are almost completely unaffected by man and are eligible for landmark status.

Recommendations

Because of the abundance of excellent karst features in Puerto Rico, this must be considered a secondary recommendation. The Camuy Cave System and north coast karst features definitely have a higher. priority. However, the Quebrada is truly beautiful and unusual in its own right and also deserves consideration.

Themes emphasized: Karstic phenomena

Selected References

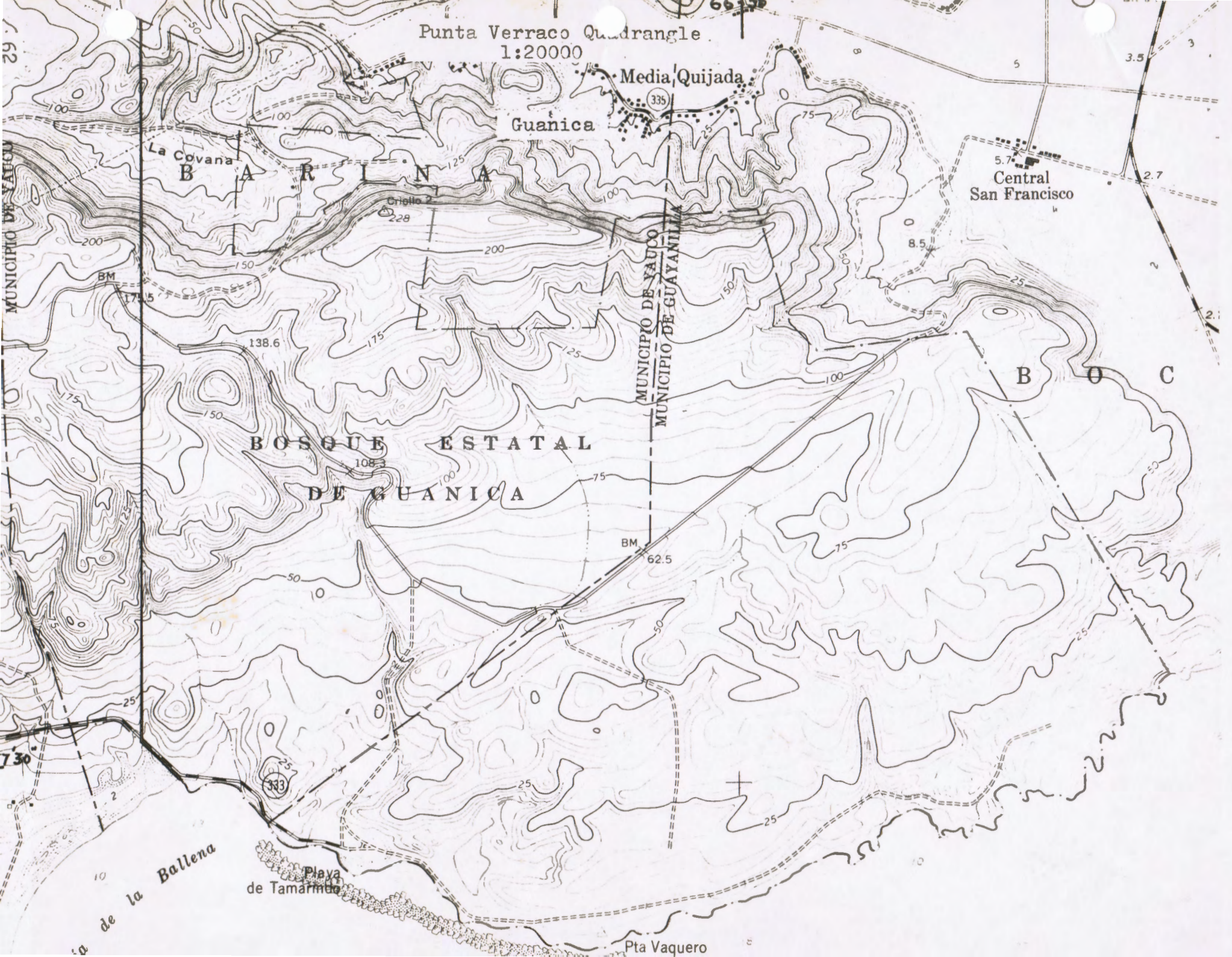
Beck, B.F., 1973. Size-frequency distribution of recent sediments from a cave-spring system in southern Puerto Rico and their significance with respect to hydrology and transportation: Proc. Sixth Int. Congr. of Speleol., 1973, Olomouc, Czechoslovakia, in press.

_____, 1974. Geology and hydrology of the El Convento Cave-Springs System, southwestern Puerto Rico: Int. J. of Spel., v. 6, no. 2, p. 93-107.

Moussa, M.T., 1969. Quebrada de Los Cedros, southwestern Puerto Rico, and its bearing on some aspects of karst development: J. Geol., v. 77, no. 6, p. 714-720.

Data Source: Dr. Barry Beck

Other knowledgeable persons: Dr. Mounir T. Moussa


Punta Verraco Quadrangle
1:20000
Media Quijada
335
Guanica
La Covana
B A R L N A
Criollo 2
228
MUNICIPIO DE YAUCO
MUNICIPIO DE GUAYANILLA
Central
San Francisco
5.7
8.5
2.7
BM
175.5
138.6
B O C
BOSQUE ESTATAL
DE GUANICA
108.3
BM
62.5
333
Playa
de Tamarindo
Pta Vaquero
730

Area Designation: The eastern Guanica Forest, particularly the coastline and Cueva de Los Murcielagos de Guanica. 1C

Location: Southwestern Puerto Rico extending approximately from longitude 66°51'30" 3 kms. eastward to the forest boundary, and from the Caribbean coast 2 1/2 kms. northward to the forest boundary near latitude 17°58'45". The Cueva de los Murcielagos de Guanica is located at longitude 66°51'05" and latitude 17°57'38". Punta Verraco quadrangle (1:20,000)

Size: The portion of the Guanica Forest east of longitude 66°51'30" includes roughly 7 km^2 which should be included together because of a variety of features included in close proximity.

Ownership: The Guanica Forest is a Commonwealth Forest Area and entirely owned by the Commonwealth of Puerto Rico and administrered by the Department of Natural Resources.

Current Land Use: The major portion of the Guanica Forest is totally unused, undisturbed, and undeveloped. Several unimproved dirt roads provide access and there is a ranger's cabin at Campamento Borinquen, outside the area herein considered. Hunting is totally forbidden in the forest, and the entire forest is open for recreation. However, there are no special accomodations for this use, except the beaches. The beach at Cana Gorda is heavily developed for recreation and there is a hotel definitely outside the area being recommended. There are some rustic improvements to the beach at Playa de Tamarindo, which is within the area being recommended, but this is on the periphery of the area and should not be detrimental to consideration of the major portion of this area as undisturbed. The coastline extending from Playa de Tamarindo to the east is totally undeveloped and undisturbed.

Description of Natural Values

Coastline Geology and Geomorphology

The coastline extending east from Playa de Tamarindo to the Forest property line is a series of high, cliffed promontories and intervening

pocket beaches. The rock composing the cliffs is Ponce Limestone (restricted) and features of tropical, marine limestone erosion are particularly well developed. At sea level there is a deep characteristic sea nip developed up to 2 or 3 m undercut at high wave level. Below this there is generally a flat terrace pock-marked by features of bioerosion, and below that a shallower low wave notch. Vertical solution flutes are developed on the cliff face.

The promontories are being cut back by wave attack and low, isolated, mushroom shaped stacks frequently remain off the seaward points, also showing the deep undercut notch. Wave attack from both sides of the promontories has eroded large, shallow sea caves and in some cases these have cut completely through the promontory to meet and form outstanding natural bridges. In other cases the rear portions of the sea caves have broken through to the surface causing "blowholes".

Geology and Ecology of Cueva de los Murcielagos de Guanica

The cueva de los Murcielagos de Guanica is located approximately 1 km. inland from Playa de Tamarindo at approximately 50 m elevation. The cave is a series of large rooms with frequent ceiling collapse causing numerous (6) vertical entrances. The most interesting feature of the cave is a wide, shallow (0.1-0.2 m) lake occurring within it. The lake is apparently the interception of the groundwater table as it has no drainage to it and almost zero flow. The water is brackish (55ppt Cl^-) and the level fluctuates tidally. The bottom sediment of the lake is water saturated

bat guano. To the west of the lake a small (2 m diam.) pool in a low side passage also intercepts the water level. This too is saline, but no guano is present and the water is extremely clear. In this pool are found two troglobitic, aquatic invertebrates, Typhlatya monae and an eyeless Styglomysis shrimp. These cave adapted crustaceans are extremely rare and found only where the unusual habitat of subterranean saline waters occur. In addition the cave houses an extremely large bat colony and numerous troglophylic invertebrates living in the guano.

Surficial Karst Features - Geomorphology

In certain areas of the Guanica Forest, notably near the eastern coast, the flat-lying limestone surface has developed an outstanding example of a karst pavement. The surface itself is jagged and irregular, densely pockmarked by raindrop pits and tinijitas, leaving only sharp edges of limestone between. The limestone has been broken into large rectangular blocks (clints) by the deep solutional enlargement of fractures (grikes). A stairstep topography extends upslope on the thin to medium bedded limestone layers with headward dissection causing the slow retreat of individual steps.

Terrestrial Ecology

In the relatively undisturbed portion of the Guanica Forest Reserve considered here, six zones can be distinguished on the basis of substrate and vegetation type. From south to north, in order, they are: (1) shore zone (2) rock plate zone (3) cactus scrub zone (4) thorn scrub zone (5) deciduous forest (6) semi-evergreen forest.

Three plant associations alternate in the shore zone, depending on whether the substrate is rocky, sandy or marshy. Most of the shoreline is rocky, with development of a wind-dwarfed community of sea grape and similar coastal shrubs, or sandy, with vegetation limited mostly to prostrate succulent vines, shrubs and grasses. A few marshy places in this part of the coastline have either salt **flats** or developing mangrove communities.

The remaining five zones interdigitate with one another, and are controlled mostly by soil depth and soil moisture. Just behind the shore zone large plates of bedrock are exposed, with erosion nooks and scattered soil pockets having low shrubs, grasses and cacti. Between and behind these plates several species of cactus predominate in the thin dry soil, including one endemic species. The rock plates and cactus shrub are the principal habitat of the three endemic lizard species which are characteristic of this forest reserve. Representatives of the more widespread forest lizards are seldom encountered at Guanica until one enters the next zone.

The remaining three forest zones grade more or less smoothly into one another. Thorn scrub, dominated by common acacias and mesquite, but including some rare endemic species occupies the shallowest driest soils. At the other extreme, the relatively moist ravines on the north side of the reserve have deep soils and include evergreen species characteristic of lowland forests island-wide. Exposed ridges and slopes are dominated by non-thorny deciduous trees, most of which have small, xerophytic leaves.

Areas of this forest with dense canopy and relatively little undergrowth (the least disturbed parts) are the habitat of the very rare and endangered Puerto Rican whip-poor-will, a bird species with a total population probably numering fewer than 500 pairs.

The total flora of Guanica Forest Reserve includes 31 plant species that are considered rare or endangered, and 16 that are both endemic and rare. The vertebrate animal fauna includes at least 13 endemic species of birds and lizards among 51 known or believed to occur there, 6 rare or endangered species, and 4 that are both. The invertebrate animals have not been adequately surveyed, but can be expected to contribute comparable numbers of species needing sanctuary and study in this unique area.

Area Integrity Danger

Due to its status as a Commonwealth Forest this area is not in danger of indiscriminate development. There are some plans for limited recreational expansion, but these will leave much of the forest still in its natural, undisturbed state. In particular, the cliffed coastline and the cave will probably not be modified (according to present Master Planning).

Eligibility for Landmark Status

The various natural features in the Guanica Forest combine to make this a very unusual natural area. The only portion of this area which is developed is the Playa de Tamarindo beach. Development here is minimal and this is on theperiphery of the recommended area. This should not affect its eligibility for landmark status since the remainder of the area is in a totally natural state.

Recommendations

Many features of this area are unique to the U.S. - notably the subtropical dry forest ecosystem, the cave with its unusual troglobitic fauna, and the cliffed coastline with its excellent examples of tropical marine erosion. It is here recommended that the entire eastern portion of the Guanica Forest which includes all these features, be designated in total as a national natural landmark.

Themes emphasized: Karstic phenomena, karstic and underground ecosystems, seashores, semi-arid ecosystems.

Published References

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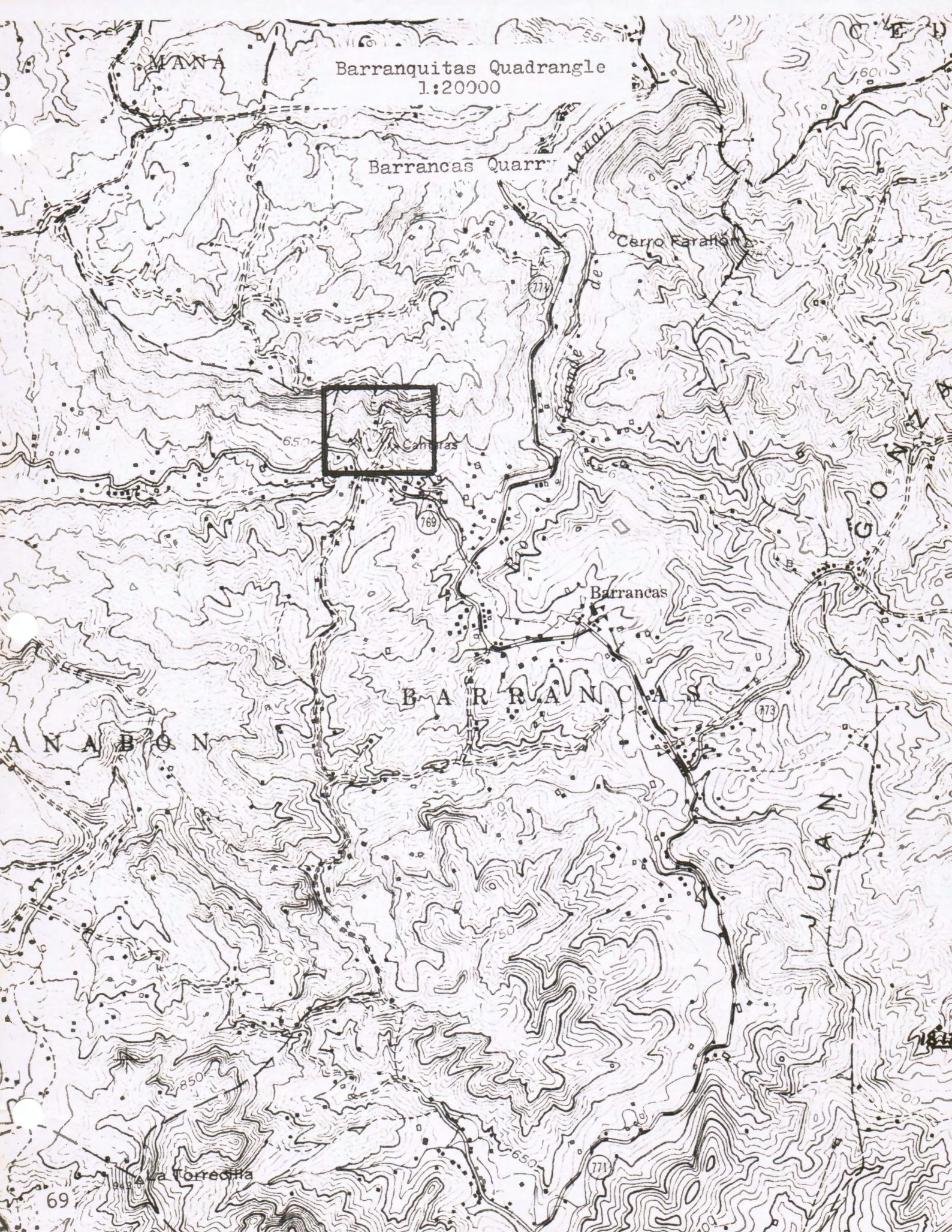
Data Source: Dr. Barry Beck

Other knowledgeable persons: Dr. Roy Woodbury
Dr. Manual Velez


Barranquitas Quadrangle
1:20000
MANÁ
Barrancas Quarr
Cerro Faralón
Barrancas
B A R R A N C A S
A N A B O N
La Torrecilla
769
773
771
774

Area Designation: Barrancas Quarry. 2B

Location: 18°14'N - 66°19'W
Barranquitas quadrangle (1:20,000)

Size: about.2 sq. kms.

Ownership: Private

Current Land Use: Quarry, some agriculture

Description of Natural Values:

Geologic

The Barrancas quarry is in the Lower Cretaceous Barrancas limestone member of the Magueyes formation, part of the Orocovis Group. It is perhaps the best fossil locality in the Lower Cretaceous in Puerto Rico containing large numbers of rudistids (Caprinids) and gastropods (Nerinea).

Just south of the quarry the view to the west displays the line of the great Damian Arriba fault, one of the major faults in the island with an estimated 25 kms. left lateral displacement and a vertical component of about 2000 m.

Area Integrity Danger

The quarry is still being worked but it is believed that even when worked out economically it will still be of value as a fossil locality. Danger to the view of the Damian Arriba fault is minimal.

Recommendations

The quarry, being a human artefact perhaps might not be considered eligible as a natural landmark and it is therefore hard to give it a high priority rating. Nevertheless the only situations in which good exposures of typical rocks are to be found in the island are where quarries or roadcuts have been made. For this reason

it is only given reduced priority, though it is highly desirable that steps should be taken to protect the site.

Themes emphasized: cuestas; mountain systems; PreCretaceous-Eocene geological history.

References

Briggs, R.P., and P.A. Gelabert, 1962. Preliminary Report of the Geology of the Barranquitas Quadrangle, Puerto Rico. U. S. Geol. Surv. Misc. Geol. Invest. Map I-336.

Data Source: R.P. Briggs

Other knowledgeable person: Dr. G. Pannella

Barranquitas Quadrangle
1:20000
Cañon de San Cristobal
Escuela Segunda Unidad de
Antonio Vasquez Ramos
Escuela Segunda Unidad de
Tomás Berrios Berdecia
PUEBLO
DEL
Helechal
BM
563.5
620.9
603.0
692.5
BM 660
Río
Torres
162

Area Designation: Canon de San Cristobal. 2D

Location: On border between Municipalities of Barranquitas and Aibonito (18°10'N - 66°18'W) Barranquitas quadrangle (1:20,000)

Size: About 1 sq. km.

Ownership: Private (diverse)

Current Land Use: nil

Description of Natural Values

This is a deep, sheer-walled canyon about 2 kms. in length incised below the upper surface known as the "St. John Peneplain". In plan it is angled into the form of a W by fault and joint control. At the lower end the Rio Aibonito makes a right-angled bend to a waterfall. It is a highly impressive geomorphological feature when viewed from its upper edges or from the air. The gorge is cut in Lower Cretaceous volcanic rocks (Robles and pre-Robles formation).

Ecology

The vegetation is of the dwarfed seasonal forest type, dwarfed because of the lack of soil. On the overhanging cliffs on the south side are festoons of climbing bamboos which are unique in that they are the only native bamboos in Puerto Rico and are not found elsewhere in the United States. On the waterfall at the eastern end bands of bluegreen, green, yellow-green and red algae render the site of great scenic beauty.

Area Integrity Danger

In the past it has been used as a garbage dump by the local municipios and although thispractice has been stopped and all signs of the dumping have been covered up, there is always danger that it may be resumed.

Recommendations

This site is unique only as regards its impressive scenic value and cannot therefore be assigned a high priority.

Themes emphasized: Plains, plateaus, mountain system, river system and lakes, PreCretaceous-Eocene geologic history, tropical ecosystem.

References

Briggs, R.P., and P.A. Gelabert, 1962. Preliminary Report of the Geology of the Barranquitas Quadrangle, Puerto Rico. U.S. Geol. Sur. Misc. Geol. Invest. Map I-336.

Data Source: Mr. R.P. Briggs
Dr. Roy Woodbury

Other knowledgeable person: none known

Jauuva Quadrangle
1:20000
Los Tres Picachos
Las Tres Palmas
Los Tres Picachos
Coabey
Escuela
Saliente Abajo
Escuela
Saliente Arriba
Saliente
Río
Salvaleón
Quebrada
BM
753.6
Río

Area Designation: Los Tres Picachos Peaks. 1D

Location: 5.5 kms. east of Jayuya, P.R., Lat. 18°13'N, Long. 66°32'W.

Size: Approximately 4 sq. kms. designated on northeast flank.

Ownership: Sucn. Jose Cintron Cardona (Box 64, Jayuya, P.R.)(Luis Oyola, Hijo) Calle Dr. Gonzalez 227, Bayamon, P.R.)

Current Land Use: Some coffee planted at lower elevation, peaks not in use.

Description of Natural Values

Las Tres Picachos Peaks stand almost in the exact geographic center of Puerto Rico. One of the two second highest points on the island (1205 meters), the highest of the triple peaks commands on a clear day one of the most majestic views available. Ocean is visible in almost every direction, with only a few other peaks intervening. This is probably the least disturbed peak area remaining in the central mountain range.

Geology

The area is divided by a NS trending fault; with the Robles Formation followed by the Vista Alegre Formation on the western upthrown side and the Tetuan Formation on the east. The Robles Formation is a series of well stratified sandstones of Lower to Upper Cretaceous age; the Vista Alegre Formation consists of bedded pyroxene-rich tuff with some volcanic breccia and is of lower Upper Cretaceous age. The Tetuan Formation is of bedded tuff with some interlayered andesitic lava. It is of Upper Cretaceous age.

Ecology

Vegetation. Approximately 40 endemic species are included in the

500-600 species making up the flora of this region. Some 17 of these are species found only in the central mountain range. About 30 of the plant species can be considered rare or endangered, of which about 7 are found only in the central range. As with other high peaks in the region, and worldwide, the vegetation of the upper zone is very slow to recover from any damage. Although none of the species presently known from Las Tres Picachos is known to be absent from neighboring mountains, at least one refuge for these delicate organisms is needed.

Animals. The fauna is not quite as diverse as that of the eastern Luquillo mountains, but it includes some of the same high altitude forms. All of the frog and lizard species are endemic to Puerto Rico. One lizard, Anolis occultus, and one bird, Dendroica angelae, are rare endemic forms.

Area Integrity Danger

The principal usage to which the higher peaks in Puerto Rico are subjected is for communications purposes. Destruction of the natural ecosystem on the higher nearby Cerro la Punta associated with construction of communication facilities has perhaps been unnecessarily great.

Recommendations

Natural Landmark status for Las Tres Picachos Peaks is recommended. Recognition of the fragility and intrinsic natural value of peak ecosystem in the central mountain range can help to minimize the danger of damage during future use. Additional biological survey and ecological study are needed in this area.

Themes emphasized: Mountain systems; tropical ecosystem: PreCretaceous to Eocene geologic history.

References

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Dansereau, P., 1967. Studies on the vegetation of Puerto Rico. Institute of Caribbean Sciences, Special Publication No. 1.

Gleason, H.A., and M.T. Cook, 1926. Plant ecology of Porto Rico, in Scientific Survey of Porto Rico and the Virgin Islands, vol. 7, New York Academy of Sciences, New York.

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Mattson, P.H., 1968. Geologic Map of the Jayuya Quadrangle, Puerto Rico. U.S. Geol. Surv. Misc. Geol. Invest. Map 1-520.

Murphy, L.S., 1916. Forests of Porto Rico, past, present and future and their physical and economic environment. U.S. Dept. Agr. Bull., No. 354, Washington, D.C.

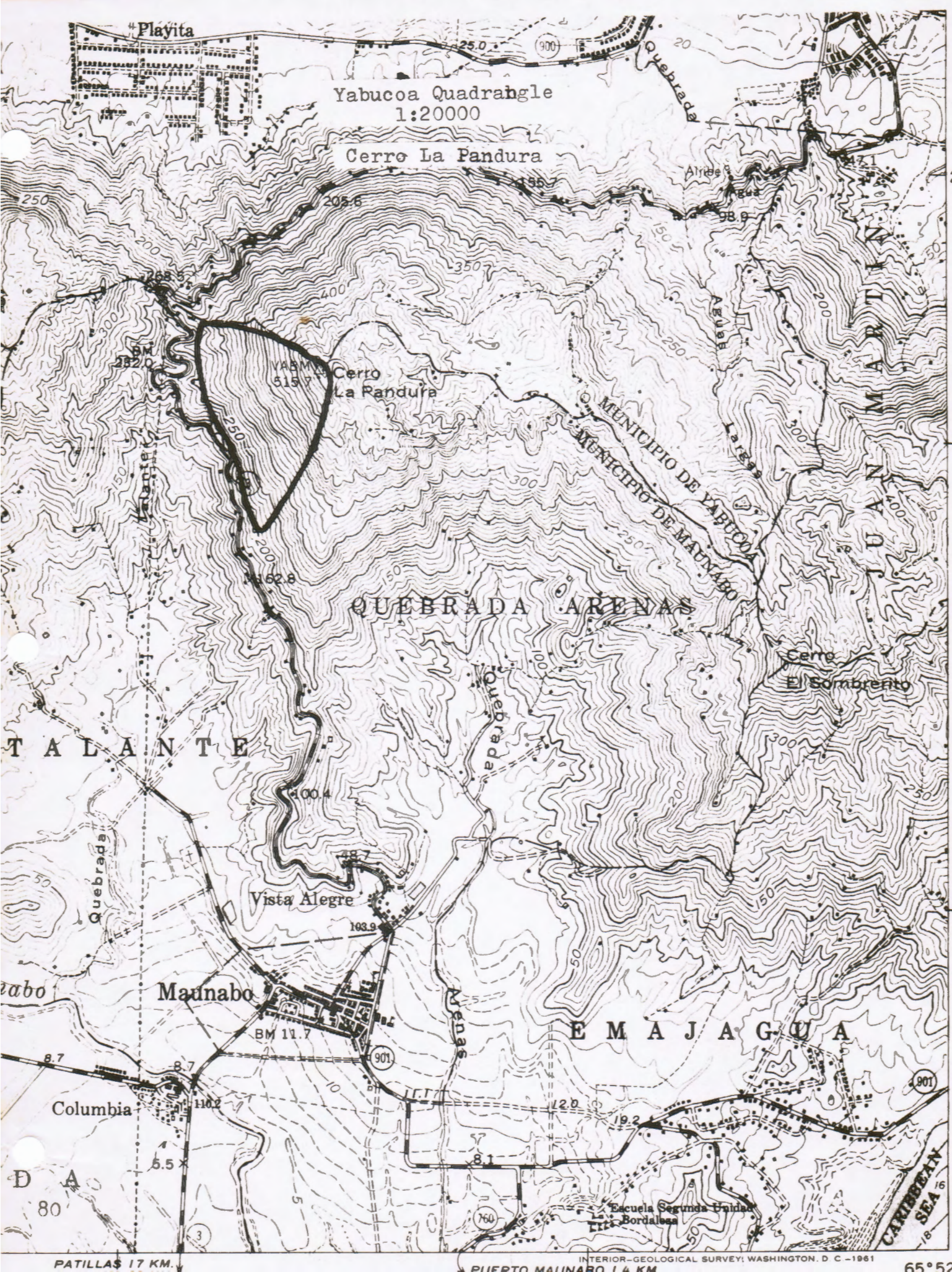
Odum, H.T., Ed., 1970. A Tropical Rain Forest. U.S. AEC Report TID-2470.

Richards, P.W., 1952. The Tropical Rain Forest. Cambridge University Press, Cambridge.

Williams, E. and Juan A. Rivero, 1965. A new anole (Sauria, Iguanidae) from Puerto Rico. Breviora (231):1-18.

Data Source: Dr. George E. Drewry

Other knowledgeable persons: Dr. Juan A. Rivero


Playita
Yabucoa Quadrangle
1:20000
Cerro La Pandura
Quebrada
Aguas
Aguas
Aguas
Cerro La Pandura
YABM
515.7
BM
252.0
MUNICIPIO DE YABUCOA
MUNICIPIO DE MAUNABO
QUEBRADA ARENAS
Cerro
El Sombrero
Quebrada
Vista Alegre
Maunabo
BM 11.7
Columbia
Escuela Segunda Unidad
Bordaleza
CARIBBEAN SEA
TALANTE
EMAJAGUA
SIERRA DE JUAN MARTIN
2'30
18°
65°52'30
PATILLAS 17 KM.
PUERTO MAUNABO 1.4 KM.
INTERIOR-GEOLOGICAL SURVEY, WASHINGTON, D C.-1961

Area Designation: Cerro La Pandura (Pandura Peak). 1D

Location: 2.4 Kilometers S.W. Yabucoa, P.R. Lat. 18°02'N, Long. 65°54'W. Yabucoa quadrangle (1:20,000)

Size: Approximately 0.3 sq. kms. designated on the southwest flank.

Ownership: Sr. Horto Rico

Current Land Use: Some coffee planted on ridges with soil, but cliffs and boulder-filled ravines relatively impassable and undisturbed. A fringe of habitations on lower boundary.

Description of Natural Values

Scenic and Geological

Pandura Peak (elevation 516 meters) and the highland shoulder southwest of it comprise the end of the Cuchilla de Panduras mountain range. The Cerro La Pandura is underlain by tonalitic intrusive rock, part of the San Lorenzo pluton. It has not yet been mapped in detail. On it the soils are sandy and very acidic. Weathering boulders have collected in the ravines, forming jumbles of stone in sizes from one to thirty meters diameter. These all but impassable boulder jumbles are known locally as guajonales. They occur here on a scale unrivalled elsewhere in Puerto Rico and form a spectacular part of the scenery. It has been suggested that these piles of great boulders may be related to tor formation. Panoramic white cliffs of exposed tonalite bedrock are also present.

Ecology

Unusual soils and the protection afforded by cliffs and guajonales have favored development and persistence of several unique floral and faunal elements on this mountain. At least three plant and three animal species are found in this limited area and nowhere

else in the world. One of the animals is a frog, Eleutherodactylus cooki, that lives in the crevices of the guajonales and is known to the local inhabitants only as a romantic sepulchral, disembodied voice, the "guajone". "No one has ever seen one!" they insist. Scientifically, the frog is interesting as a specialized, possibly relict form that could have been ancestral to other widespread local frog species...A gecko lizard is also restricted to this region, occurring on stony outcrops and cliffs. The guajonale crevices also harbor invertebrate animals that are rare or absent elsewhere, including a very large wingless species of cockroach. The vegetation is Lower Montane (Rain Forest).

Area Integrity Danger

The plant and animal species restricted to this mountain could become endangered if crevice silting due to deforestation were to increase greatly, or if the tonalite were exploited commercially. The cliffs and guajonales are not suitable for cultivation, but have been utilized along the highway at lower elevations for construction of weekend homes and scattered banana groves.

Recommendations

At least the designated area of Cerro La Pandura should be recognized as a unique natural landmark. Additional survey of the peak area and some of the large guajonales on the north face of the mountain should be undertaken.

Themes emphasized: Mountain system, tropical ecosystems.

Selected References

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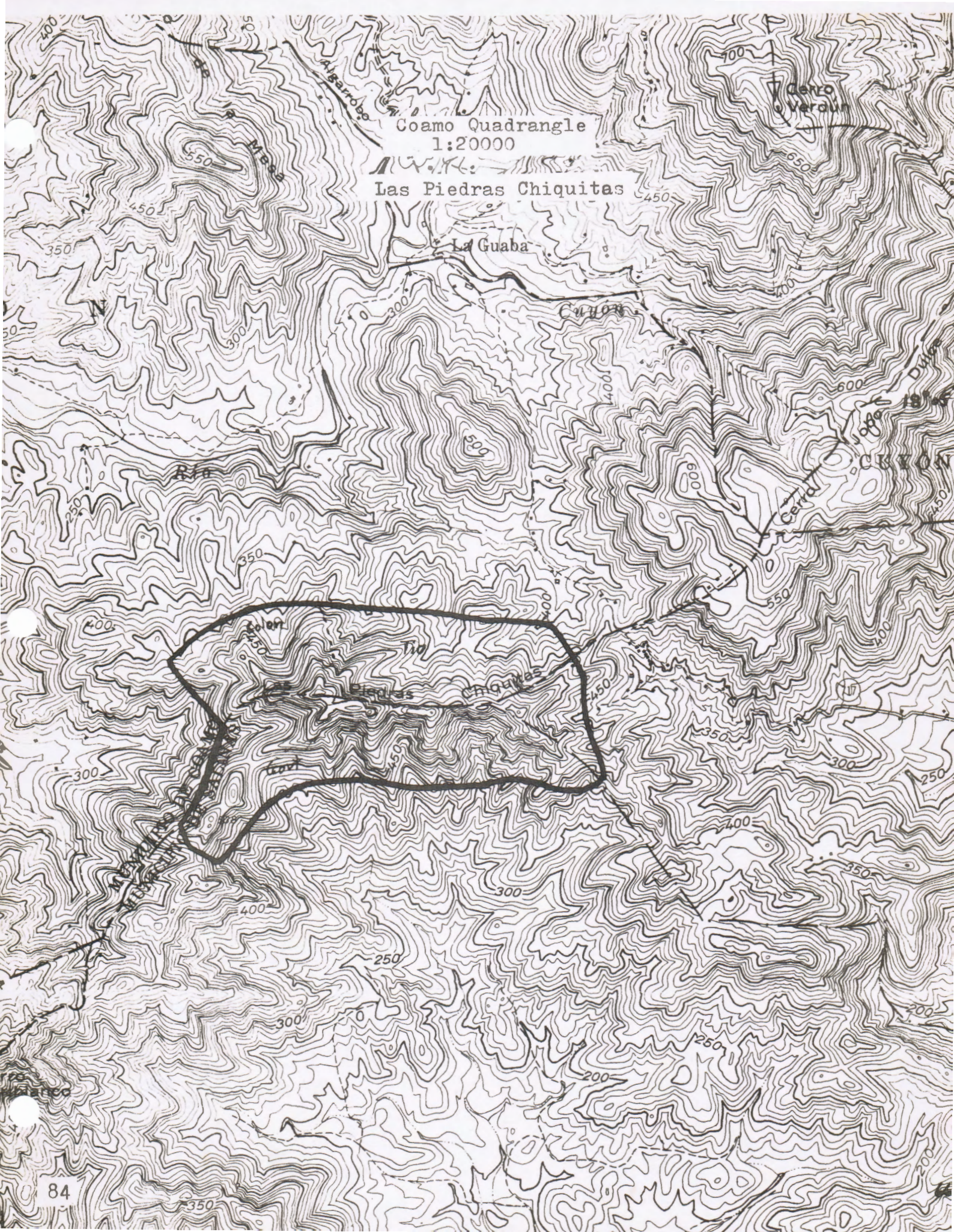
Cunningham, F.F., 1968. The significance of Caribbean Evidence in the Elucidation of Tors. Carib. Jour. Sci., v. 8, p. 187-198.

Grant, Chapman, 1932. A new frog from Puerto Rico. Jour. Dept. Agr. Puerto Rico, v. 16, p. 145-148.

Data Source: Dr. George E. Drewry

Other knowledgeable persons: Dr. Juan A. Rivero


Coamo Quadrangle
1:20000
Las Piedras Chiquitas
La Guaba
Cerro Veraún
Algarrobo
Mesa
Río
Cañón
Caída
Dulce
CAÑON
Tío
Piedras
Chiquitas

Area Designation: Las Piedras Chiquitas Mountains. 1B

Location: 7 kilometers SSW Aibonito, P.R., Lat. 18°4'N, Long. 66°16'30"W. Coamo quadrangle (1:20,000)

Size: Approximately 1.6 sq. kms.

Ownership: South slope - U.S. Government Military Reservation.
North slope - Sr. Jose Colon Rodriguez (Box 13, Coamo, P.R.)
Sr. Aurelio Tio (Santurce, P.R.)

Current Land Use: South slope - little use, north slope - pasture

Description of Natural Values

Scenic and Geologic

The Las Piedras Chiquitas Mountains are a picturesque, thin ridge of spurs rising to 610 meters in an east-west row just south of the southern rim of the central mountains (± 800 meters at that point).

The ridge is formed of coarse volcaniclastic conglomerate of the Cariblanco formation of Upper Cretaceous (Santonian age). At the eastern end of the ridge there occurs an interbedded lava flow, the La Guaba lava member of probably basaltic composition. Possibly the driest mountains of their elevation along the south coast of Puerto Rico, these are situated in a unique climatic zone created by downdrafting of air deflected southward around the high elevations of the central mountain massif. Air temperatures are usually cool at this altitude, enough to cause heavy nightime dewfall and some cloud particle formation, but annual rainfall in the region averages only 100-130 cm annually, due mostly to the downdrafting. Soils are extremely dry.

Ecology

Conditions of cool, moist air but very dry soil have encouraged

the growth of unusual plant associations. Most of the rooted vegetation is composed of xerophyllous species, including thorny scrub and even cacti. Most of the available surfaces of rocks and branches, however, support a dense, luxuriant growth of epiphytic plants, including species of orchids and bromeliads that are rare or absent elsewhere. An incomplete plant survey by Dr. Roy Woodbury of the University of Puerto Rico in the early 1960's revealed the presence of several such restricted plant species. Pasturing on the north slopes since then has removed most of the plant cover except for grasses, but the extremely steep and inaccessible south slopes have retained natural vegetation. A rare lizard species, Anolis poncensis, has been reported from the area. This is possibly one of the very few habitats of a rare livebearing frog (the only such frog known in the western hemisphere) which is still in the process of being scientifically described.

Area Integrity Danger

In this general area of unusually dry mountains the peaks are in demand for dwelling construction sites, because they tend to have year round cool, dry climates, and are accessible via unpaved roads that are less susceptible to erosion than in wetter mountain areas. Pasturing is also carried to the mountain summits. Las Piedras Chiquitas has so far avoided some of this development because of its extreme steepness, and because of the military reservation on its southern flank.

Recommendations

The scenic and ecological uniqueness of Las Piedras Chiquitas should be recognized by as a natural landmark.

Themes emphasized: Mountain system, tropical ecosystem, PreCretaceous-Eocene geologic history.

Selected References

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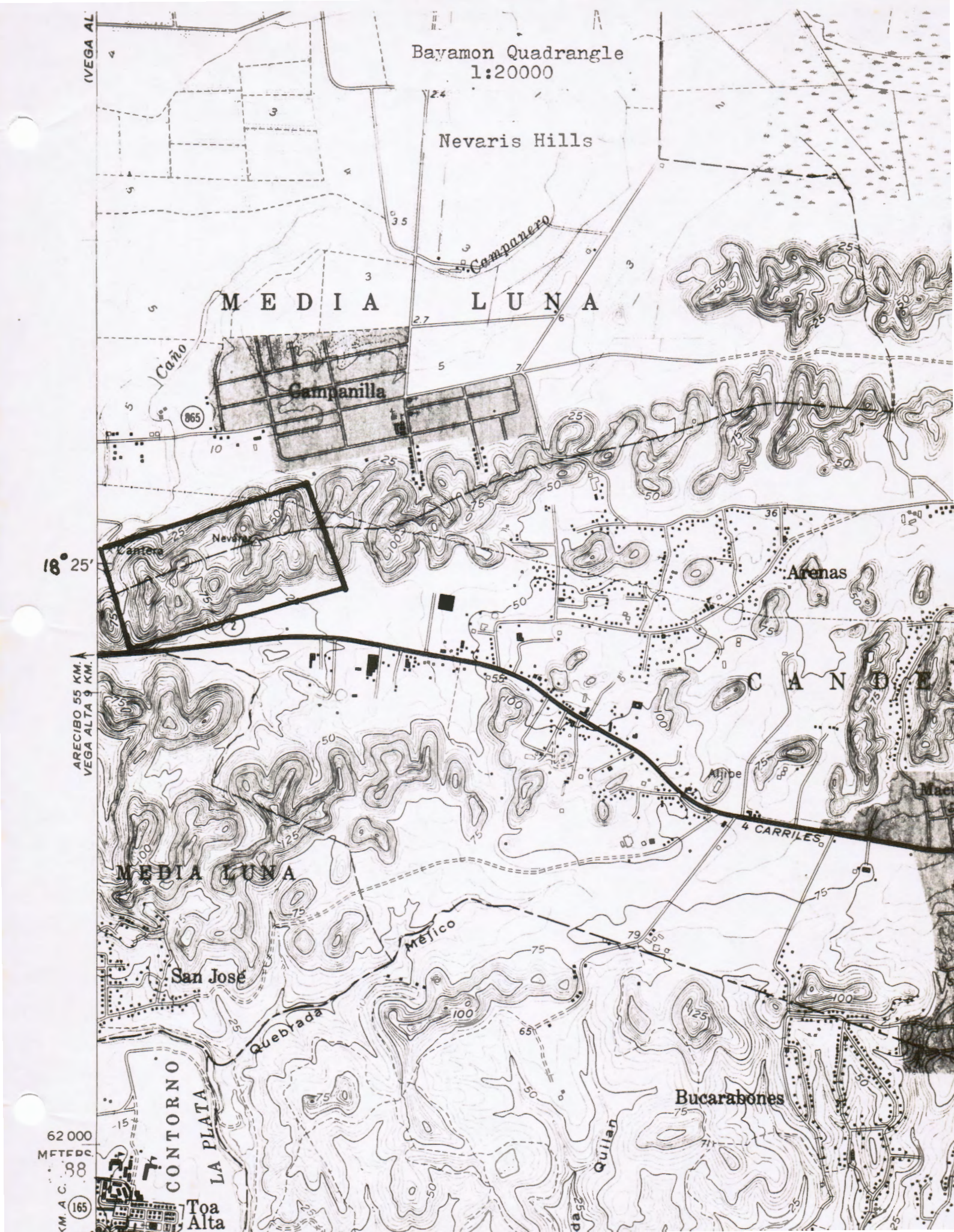
Grant, Chapman, 1931. A new species and two new subspecies of the genus Anolis. Jour. Dept. Agr. P.R. 16(3):215.

Woodbury, Roy. Personal communication.

Data Source: Dr. George E. Drewry

Other knowledgeable person: Dr. Roy Woodbury


Bayamon Quadrangle
1:20000
Nevaris Hills
MEDIA LUNA
Campanilla
Caño
Campanero
Cantera
Nevaris
Arenas
CANDELARIA
Aljibe
4 CARRILES
MEDIA LUNA
Mejico
San José
Quebrada
CONTORNO
LA PLATA
Toa Alta
Bucarabones
Quilan
18° 25'
62 000
METERS
ARECIBO 55 KM.
VEGA ALTA 9 KM.
VEGA AL
865
165

Area Designation: "Nevaris Hills", nr. Camparilla. 2D

Location: Latitude 18°28'N, Longitude 66°15'W. Bayamon quadrangle (1:20,000)

Size: Approximately 0.5 sq. kms.

Ownership: Private (Sr. Nevaris)

Current Land Use: The flat land along Highway #2 is in pasture; the hills are in their natural state.

Description of Natural Value

Geology

The four hills are typical mogotes composed of Aguada limestone capped with Aymamon limestone, both of Miocene age and moderately fossiliferous. The flat land surrounding them is covered by Tanama stoney clay, a poor soil which is now under pasture.

Ecology

These hills support a very diversified mature vegetation with many large trees especially near their base and on the upper ledges. It is probably one of the few remaining patches of original vegetation in spite of its proximity to the metropolis. It produces over 170 species of trees of which 42 are over 1 ft. in diameter, 13 over 2 ft.; 32 species over 70 ft. tall and 12 over 90 ft. The tallest, Phoebe elongata is estimated to be 120 ft. tall. Of the total 400 plant species over 40 are rare and endangered. Typical forest birds, lizards and the Puerto Rican boa are frequently seen.

Area Integrity Danger

The principal danger arises from its proximity to the San Juan metropolis. The mogotes themselves are not likely to be damaged.

Recommendations

Considerations should be given to this site for Natural landmark

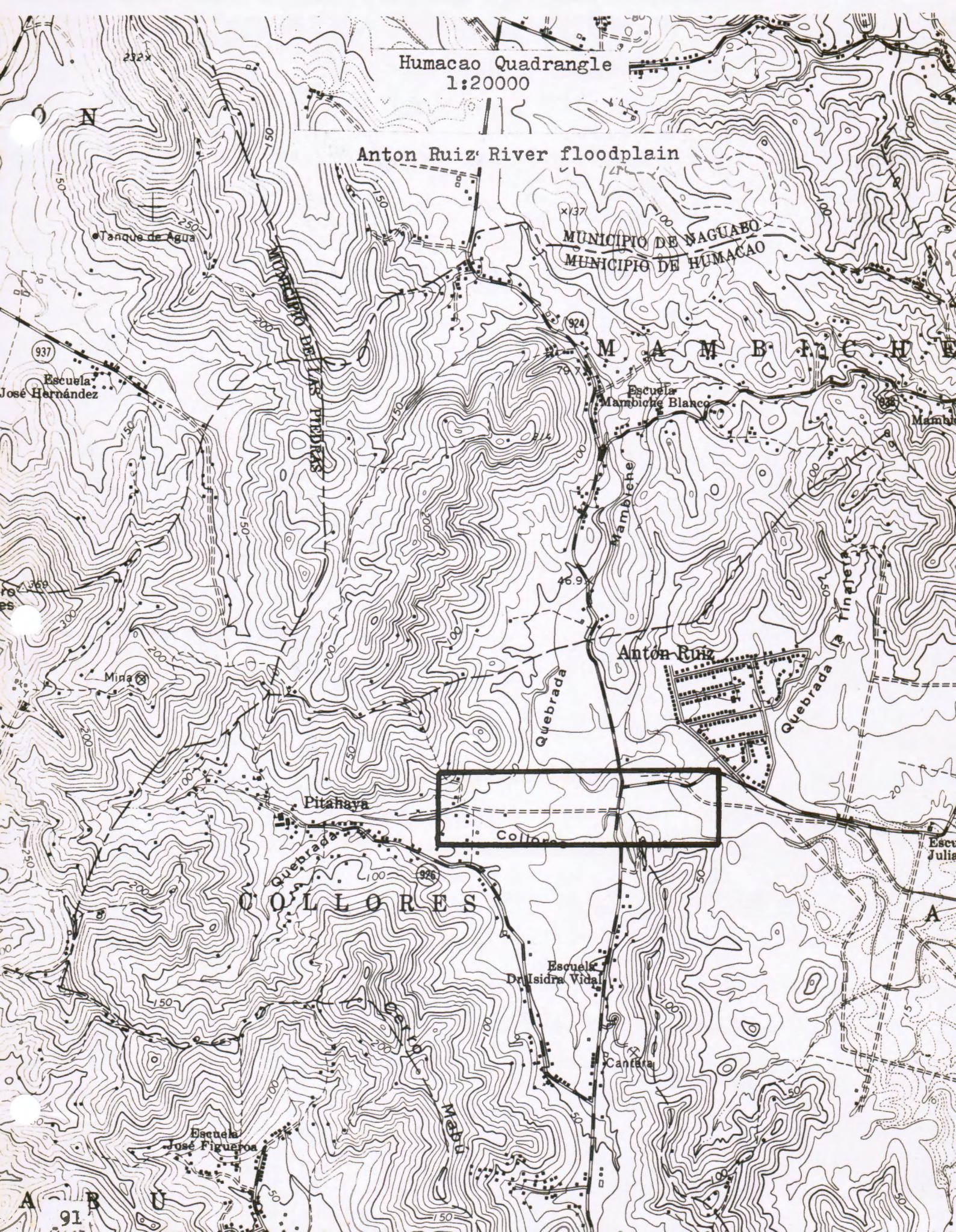
status since it is apparently one of the few remaining patches of original vegetation. It is, however, similar to the Miraflores site and in a more vulnerable situation. It can only be given secondary priority.

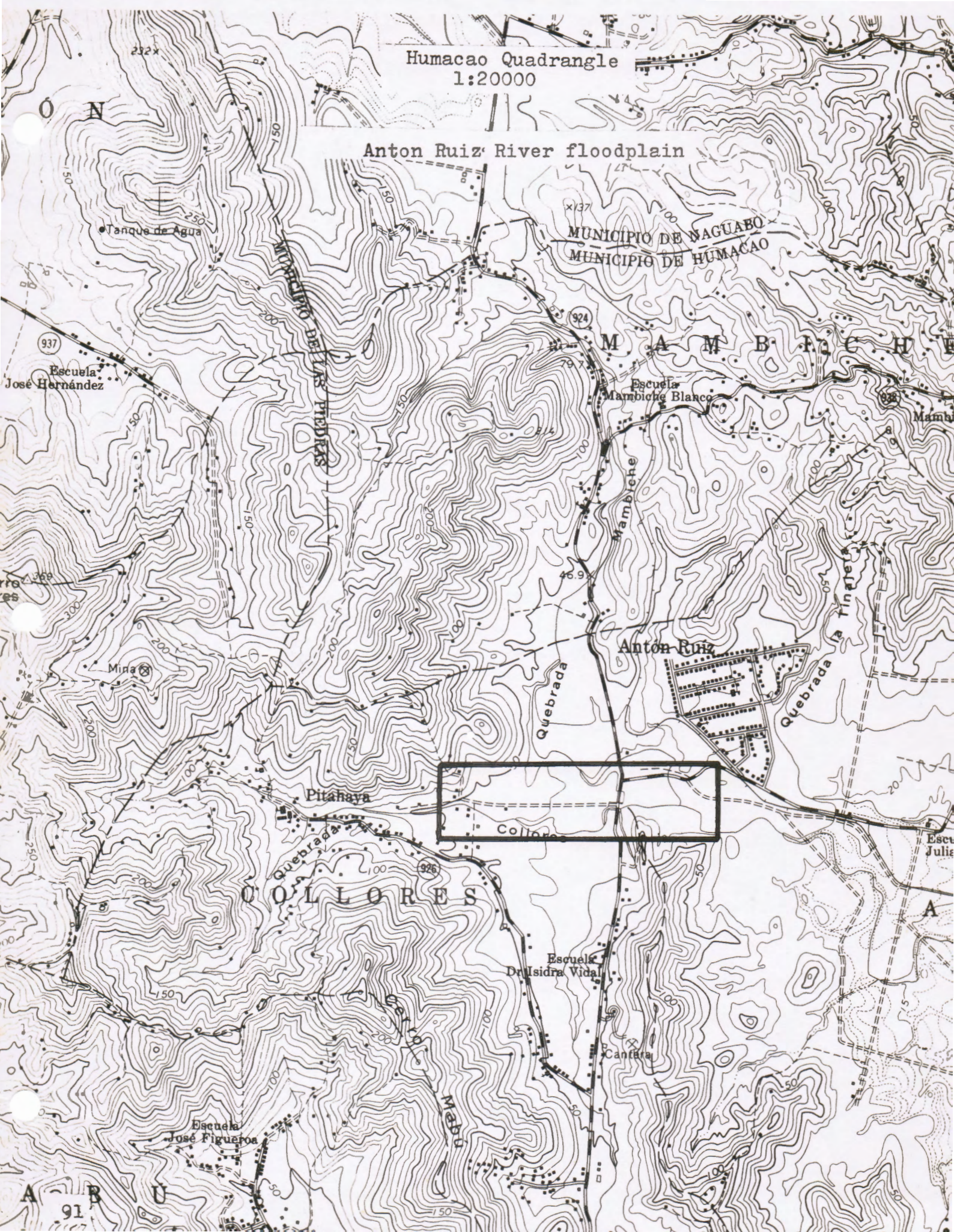
Themes emphasized: Karst; tropical ecosystems.

References none known

Data Source: Dr. Roy Woodbury

Other knowledgeable person: none known


Humacao Quadrangle
1:20000
Anton Ruiz River floodplain
MUNICIPIO DE NAGUABO
MUNICIPIO DE HUMACAO
MUNICIPIO DE LAS PIEDRAS
Tanque de Agua
Escuela José Hernández
Escuela Mambiche Blanco
Mambiche
Quebrada
Quebrada La Tinaja
Antón Ruiz
Mina
Pitahaya
Quebrada
COLLORES
Escuela Dr. Isidra Vidal
Cantera
Escuela José Figueroa
924
925
926
937
46.9
91


Humacao Quadrangle
1:20000
Anton Ruiz River floodplain
MUNICIPIO DE NAGUABO
MUNICIPIO DE HUMACAO
MUNICIPIO DE LAS PIEDRAS
Tanque de Agua
Escuela José Hernández
Escuela Mambiche Blanco
Mambiche
Quebrada
Quebrada la Tinaja
Antón Ruiz
Mina
Pitahaya
Quebrada
Collores
COLLORES
Escuela Dr. Isidra Vidal
Cantara
Mabu
Escuela José Figueroa
937
924
926
91

Area Designation: Anton Ruiz river floodplain. 1D

Location: Latitude 18°11'N, Longitude 65°48'W

Size: About .4 sq. km.

Ownership: Private

Current Land Use: Drainage of surrounding sugarcane land. Some cattle are pastured on it.

Description of Natural Values

Geology

The area is in the floodplain of the river Anton Ruiz. The surrounding rocks are Lower Cretaceous volcanics but they have not yet been studied or mapped.

Ecology

This is a swamp forest, dominated by one species, Pterocarpus officinalis. The total number of vascular plants is less than 50. The rare fern Polypodium duccumanicus and the rare herbaceous shrub Costus sp. are common. It is also the habitat of aquatic birds among them the rare West Indian tree duck.

Area Integrity Danger

Excessive pumping may damage the site.

Recommendations

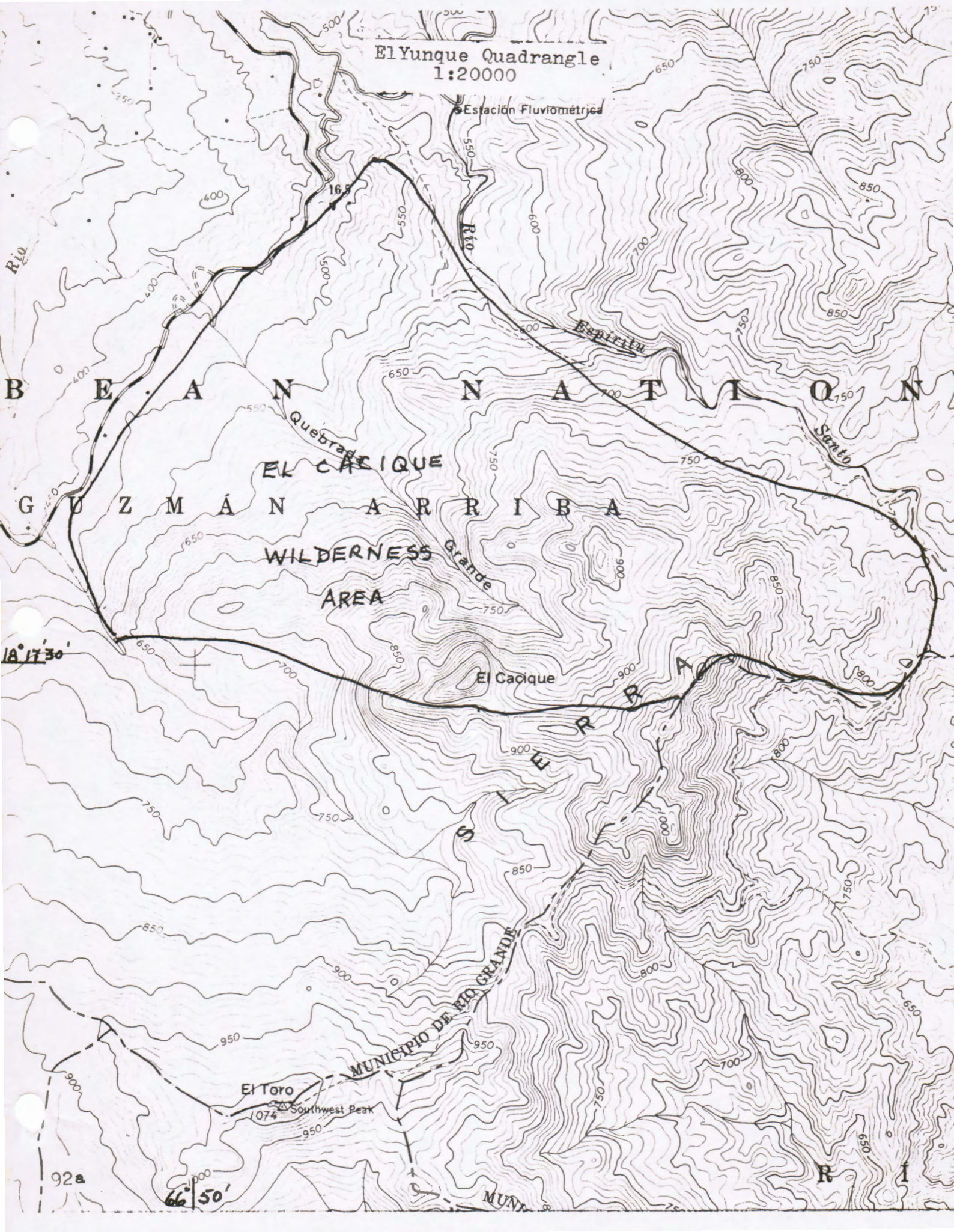
This is the sole remaining example of a Pterocarpus swamp forest which is not found elsewhere in the United States. It is therefore given high priority for natural landmark status.

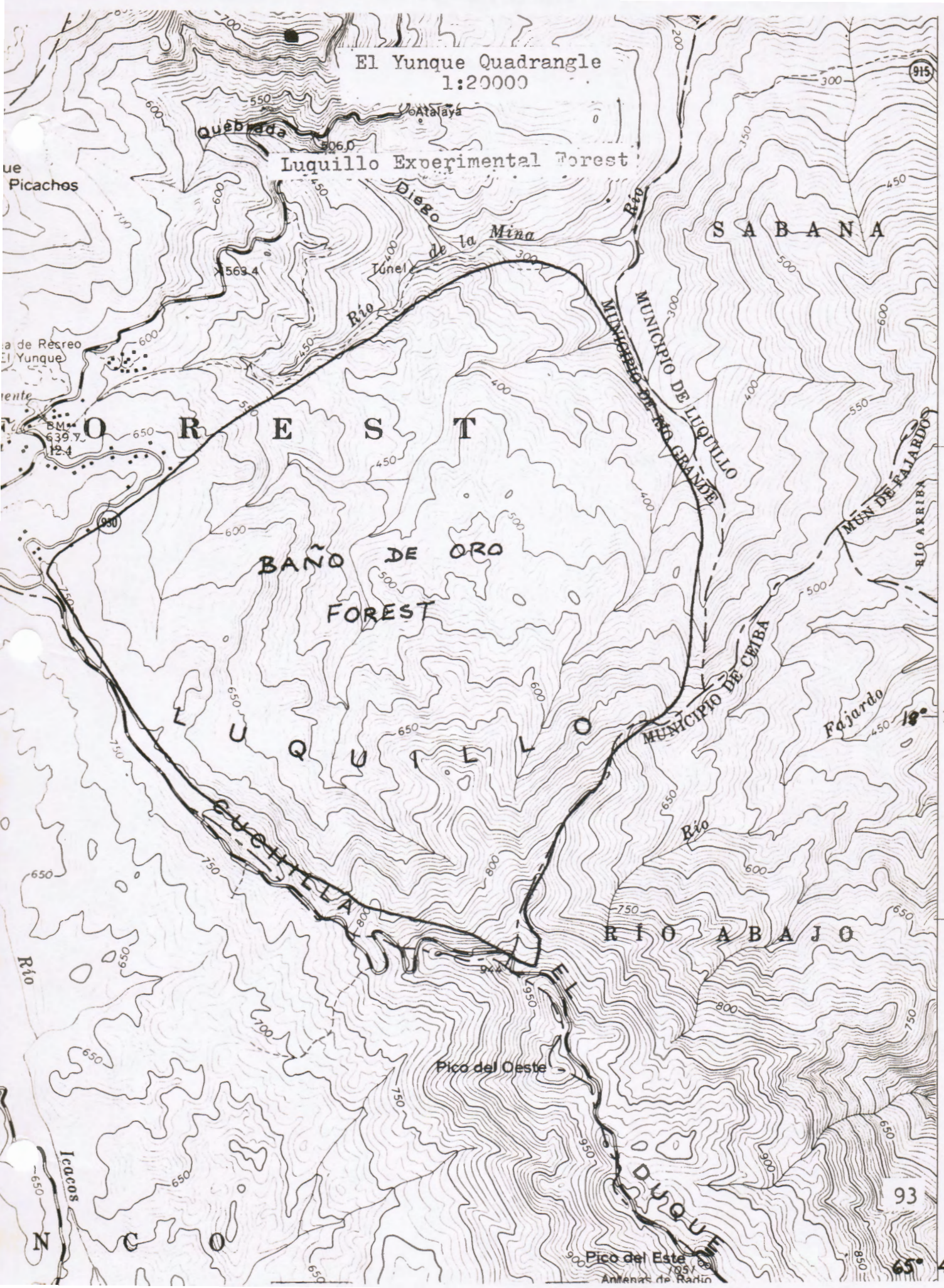
Themes emphasized: Tropical ecosystems.

References: none known

Data Source: Dr. Roy Woodbury

Other knowledgeable person: none known


El Yunque Quadrangle
1:20000
Estación Fluviométrica
Río
Río
Espíritu
Santo
Quebrada
EL CACIQUE
WILDERNESS
AREA
Grande
El Cacique
SIERRA
MUNICIPIO DE RIO GRANDE
El Toro
Southwest Peak
1074
BEANNATION
GUZMÁN ARRIBA
18°17'30"
66°50'
92a


El Yunque Quadrangle
1:20000
Luquillo Experimental Forest
Quebrada
Atalaya
506.0
Picachos
Diego
Río
de la Mina
Túnel
X563.4
SABANA
Río
MUNICIPIO DE LUQUILLO
MUNICIPIO DE RIO GRANDE
Área de Recreo
El Yunque
BM
639.7
12.4
FOREST
BAÑO DE ORO
FOREST
MUN DE FAJARDO
RIO ARRIBA
LUQUILLO
MUNICIPIO DE CEIBA
Fajardo
17'30"
CUCHILLA
Río
RIO ABAJO
EL
Pico del Oeste
Icacos
DUQUE
93
Pico del Este
Antenas de Radio
65° 45'

Area Designation: The Luquillo Experimental Forest, particularly the areas known as "The Bano de Oro Forest" and "The El Cacique Wilderness Area". 1C

Location: Luquillo Experimental Forest extends from Lat. 18°15' to 18°21'30"N, and from Long. 65°42.30" to 65°54'W. The Bano de Oro Forest area is centered at Lat. 18°17'30"N, and Long. 65°46'W. The El Cacique Wilderness area is centered at Lat. 18°18'N and Long. 65°49'W.
El Yunque quadrangle (1:20,000)

Size: The forest covers an area of 250 kms^2.

Ownership: The United States Federal Government. Dept. of Agriculture, Forest Service.

Current Land Use: Experimental forest management, communications installations, water source for nearby cities and towns, recreation, research, game preserve, and natural and wilderness areas.

Description of Natural Values

Scenic

The forested mountains of the northeastern Puerto Rican Luquillo mountain range are clearly visible from the city of San Juan. Four of its peak areas rise above 1000 meters in elevation.

Hydrological

Orographic rain is developed when moist easterly trade winds strike the Luquillo mountain range and are uplifted, making this mountain range the wettest part of the island. Water discharge from the forest has been estimated at about 85% of approximately 6×10^9 m^3/yr. precipitation input.

Geological

The rocks consist essentially of volcaniclastic sediments, probably of Lower Cretaceous age, intruded by the Rio Blanco stock, composed of quartz diorite and some diorite. A fairly broad zone

of contact metamorphism surrounds the stock. The El Cacique area is underlain by the Hato Puerco formation that also consists of volcaniclastic sediments with interbedded calcareous marlstone containing foraminifers of Upper Cretaceous age. This formation is also widely metamorphosed at some distance from the stock. Minerals found have included gold, copper, silver, iron, marble, sulfur and mercury, mostly in concentrations lower than commercially extractable.

Terrestrial Ecology

Above its lower boundaries at approximately 100 meters elevation, the forest can be divided roughly into four plan associations or zones. In ascending order, three can be specified on their dominant tree species, tabonuco, palo colorado, and sierra (mountain) palm zones. The wind-dwarfed vegetation of the summits is variously known as dwarf, mossy or elfin forest. In the Holdrige system of ecological life zones are also recognizable subtropical wet forest, lower montane wet forest, lower montane rain forest, and subtropical rain forest.

Timber has been removed from much of the lower elevations, but some areas, particularly the one known as the Bano de Oro, have been left in almost virgin condition. Much of the forest periphery was planted in coffee until the land was acquired for the forest reserve some 30-40 years ago. The upper, elfin forest zone has no trees of commercial timber value, and has remained relatively undisturbed except for the construction of roads and communications facilities on two of the four principal peaks. The El Cacique Wilderness Study area has been left without even a primary trail leading into it, and

consists mostly of sierra palm forest and elfin forest. The designated areas contain the best of the elfin forest types in El Yunque. Rates of recovery in peak vegetation following known dates of disturbances on other peaks indicate that this is by far the most fragile zone in the system, and will probably require centuries for full recovery following any cutting or similar disturbances.

Some 207 native tree species and an additional 50 introduced tree species are now known from the Luquillo Experimental Forest. Of these, 61 are species endemic (restricted) to Puerto Rico, and 26 are known only from this forest reserve. About 4 of the tree and shrub species are extremely rare. There are more herbaceous plant species listed than trees, bringing the species total to about 600 species, but none of the herbaceous species are listed as rare.

Approximately 63 species of vertebrate animals are permanent residents within the forest boundaries. At least 29 of these are endemic to Puerto Rico, and 4 are found only in this forest. One of them, the Puerto Rican parrot, has been placed by the U.S. Department of Interior in the status of very endangered species. Fewer than 20 individual parrots of this species now find their only sanctuary here. One lizard and one frog species are found only near the summits of these few mountains. One warbler and one other lizard are peak dwellers listed as rare, but also occuring on other Puerto Rican mountains. Between 10 and 25 migrant bird species (mostly warblers) appear annually as transients and round out the vertebrate avifauna.

More study is needed before the fauna of invertebrate animals can even be estimated. More than 1800 species of insects alone

have been collected in the forest. Of these nearly half are Puerto Rican endemic species, of which one fifth to one third have not been taken outside this forest.

Area Integrity Danger

The area is part of the Caribbean Natural Forest and danger to integrity is minimal.

Eligibility for Landmark Status

The uninhabited and undisturbed condition of the Bano de Oro Forest and El Cacique Wilderness Area make them primary candidates for the status of National Natural Landmarks. Neither of them is duplicated elsewhere in the United States or its territories.

Recommendations

The Luquillo Experimental Forest, and particularly the Bano de Oro Forest area and El Cacique Wilderness area are high priority recommendations for natural landmarks.

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Seiders, V.M., 1971. Geologic Map of the El Yunque Quadrangle, Puerto Rico. U.S. Geol. Surv. Misc. Geol. Invest. Map I-658.

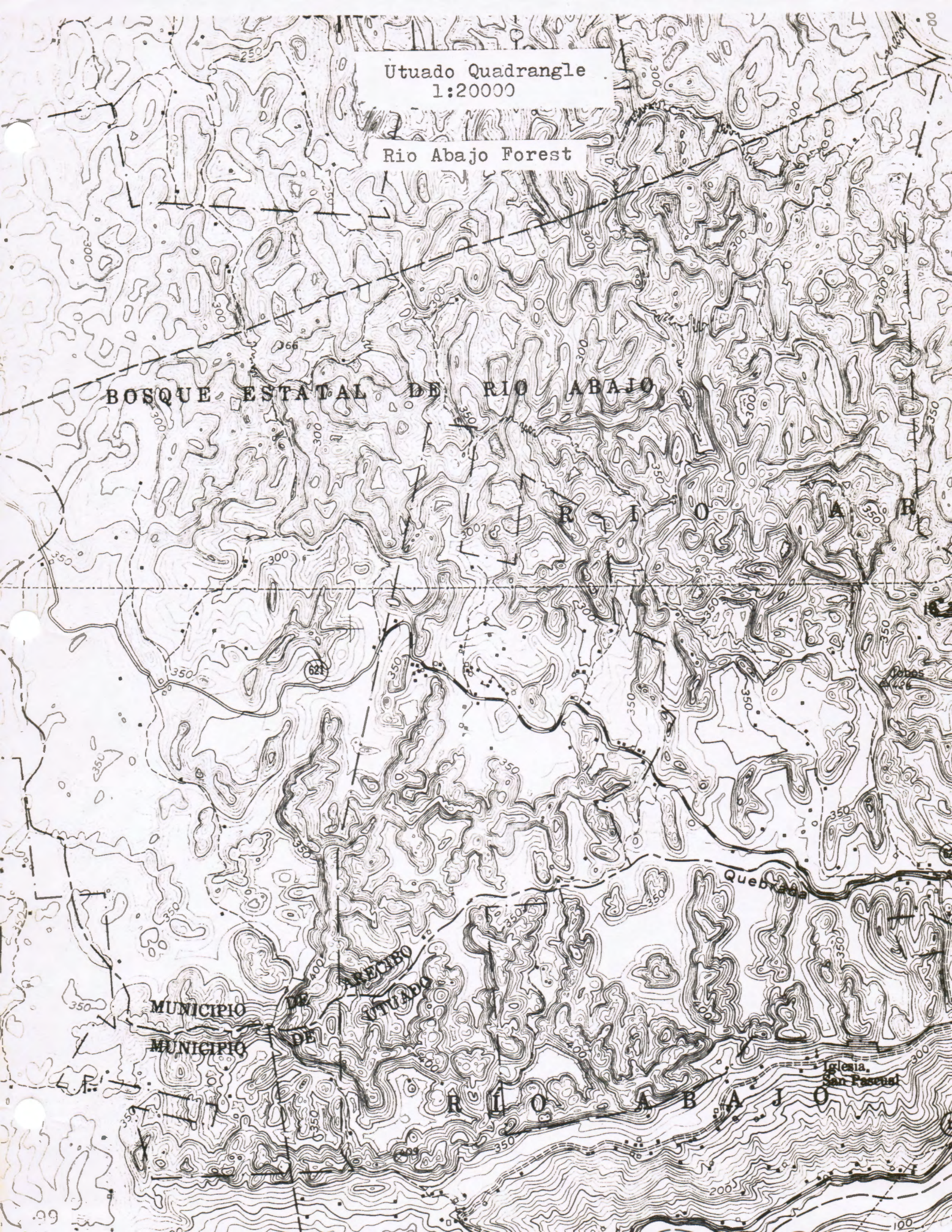
Stejneger, L., 1904. The herpetology of Puerto Rico. Rept. U.S. Nat. Mus., 1902:597.

Williams, E., and J.A. Rivero, 1965. A new anole (Sauria, Ignuanidae) from Puerto Rico. Breviora (231):1-18.

Themes emphasized: Mountain systems; tropical ecosystems.

Data Source: Dr. George E. Drewry

Other knowledgeable persons: Dr. F.H. Wadsworth
Dr. Juan A. Rivero
Dr. Roy Woodbury


Utuado Quadrangle
1:20000
Rio Abajo Forest
BOSQUE ESTATAL DE RIO ABAJO
RIO ABAJO
621
Quebrada
MUNICIPIO DE ARECIBO
MUNICIPIO DE UTUADO
RIO ABAJO
Iglesia
San Pascual

Area Designation: Rio Abajo Forest. 1D

Location: 18°20'N - 66°42'W

Size: Approximately 20 sq. kms.

Ownership: Commonwealth Government, Dept. of Agriculture

Current Land Use: Recreational

Description of Natural Values

Geological

The forest is situated on the top surface of Mid-Tertiary limestones, (Lares limestone overlain by the Cibao formation) lying unconformably on the Older Series, in this case Eocene Yunes and Jobos formations. It is one of the only areas where the unconformity can be well seen. It forms a steep escarpment. Karstic forms are strongly developed on the limestone with large sinkholes, some 30 m deep or more; tower karst is particularly impressive. Very fine views of the surrounding country and particularly of the impressive canyon on the Rio Grande de Arecibo are available at various points.

Ecology

The vegetation is of seasonal formation with four different types deciduous, semi-deciduous, evergreen and thorn scrub. Thirty species are rare in Puerto Rico. Over 500 species are found, none known in the United States elsewhere. Included is a very large Cedro Macho which is unique to Puerto Rico and Haiti.

Area Integrity Danger

There are already camp facilities and the area is available to the general public. However, it is unlikely that any great damage to the area as a whole will result. Possible improvement of Highway 10 which passes adjacent to the area may result in some damage,

particularly perhaps by attracting larger numbers of visitors.

Recommendations

This area is recommended as high priority for a natural landmark. It is unique in that it has one of the best and most impressive examples of towerkarst together with other karstic features. The cuesta formed by the Mid-Tertiary limestones overlying unconformably the older volcanics is here magnificently developed. This is probably one of the best forest areas in the island in terms of the number of species and the size of the trees.

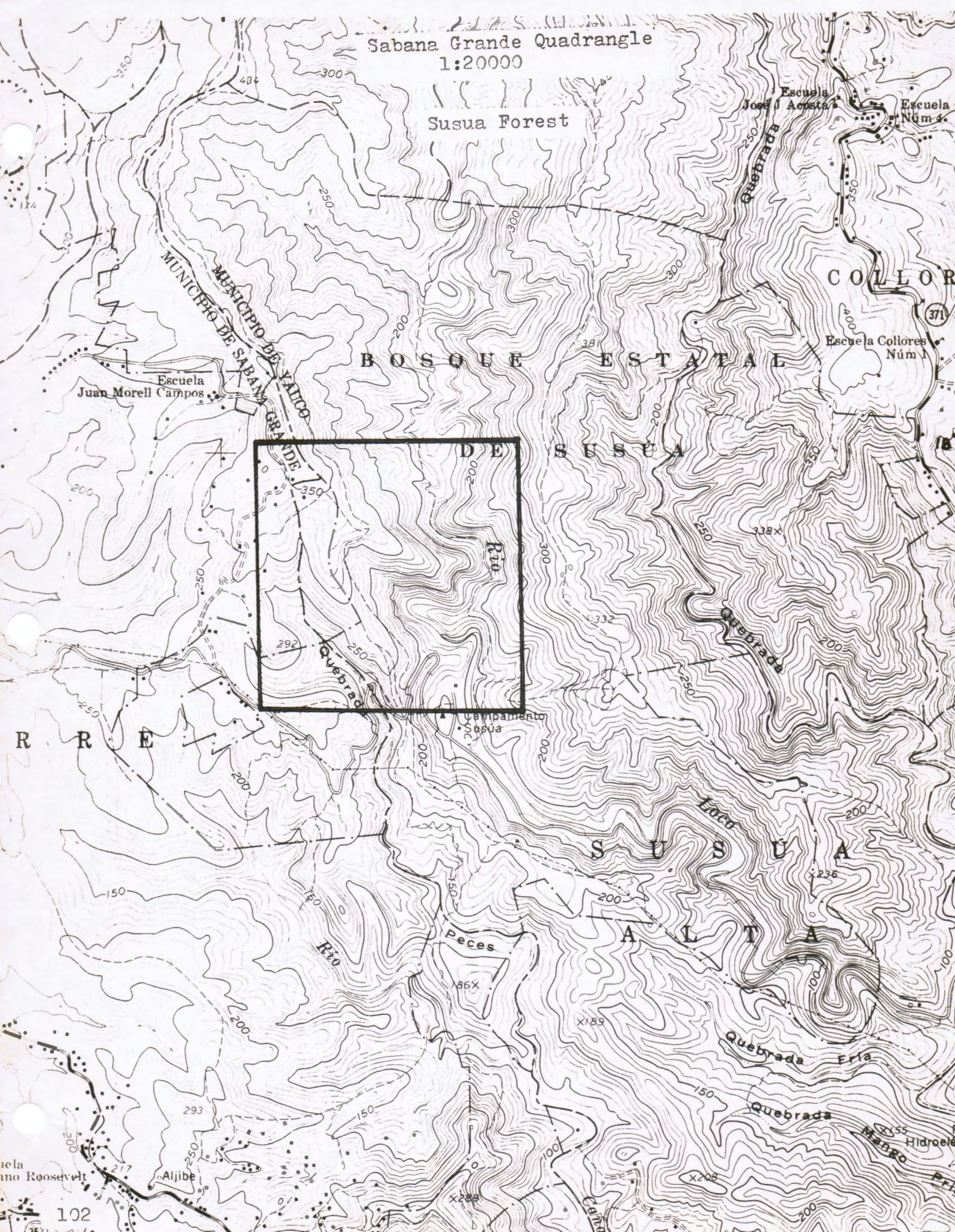
Themes emphasized: Cuestas; Karstic phenomena; Tropical ecosystem; Oligocene-Recent geologic history.

References

Nelson, A.E., 1967. Geologic Map of the Utuado Quadrangle, Puerto Rico. U.S. Geol. Surv., Misc. Geol. Invest. Map I-480.

Data Source: Personal observation. Dr. Roy Woodbury

Other knowledgeable person: none known


Sabana Grande Quadrangle
1:20000
Susua Forest
Escuela
José J Acosta
Escuela
Núm 4
Quebrada
COLLOR
371
Escuela Collores
Núm 1
BOSQUE ESTATAL
DE SUSUA
MUNICIPIO DE YAUCO
MUNICIPIO DE SABANA GRANDE
Escuela
Juan Morell Campos
Río
Quebrada
Campamento
Susúa
Quebrada
Loco
SUSUA
ALTA
Río
Peces
Quebrada Fría
Quebrada
Mango
Hidroele
Aljibe
Roosevelt
102

Area Designation: Susua Forest. 2D

Location: Latitude 18°05'N, Longitude 66°55'W
Sabana Grande quadrangle (1:20,000)

Size: Approximately 1 sq. km.

Ownership: Commonwealth of Puerto Rico

Current Land Use: Recreation; the designated area is more or less in its natural state.

Description of Natural Values

Geology

The area is situated on the larger serpentinite body in S.W. Puerto Rico. The soil derived from the serpentinite is dark red to purple in color and of high porosity.

Ecology

Although the area receives about 150 cm of rainfall, it is very dry due to the high permeability of the soil. A very unique dwarfed vegetation results, of dry deciduous woodland type. There are 25 or more endangered species and three endemic trees (Rheedia hessii, Linociera holdrigii and Calyptranthes triflora.) The fauna although not well known is likely to be unique. Breeding birds include whip-poor-will and quail doves.

Area Integrity Danger

The area is a state forest. However, there is some possible danger from extension of recreational facilities.

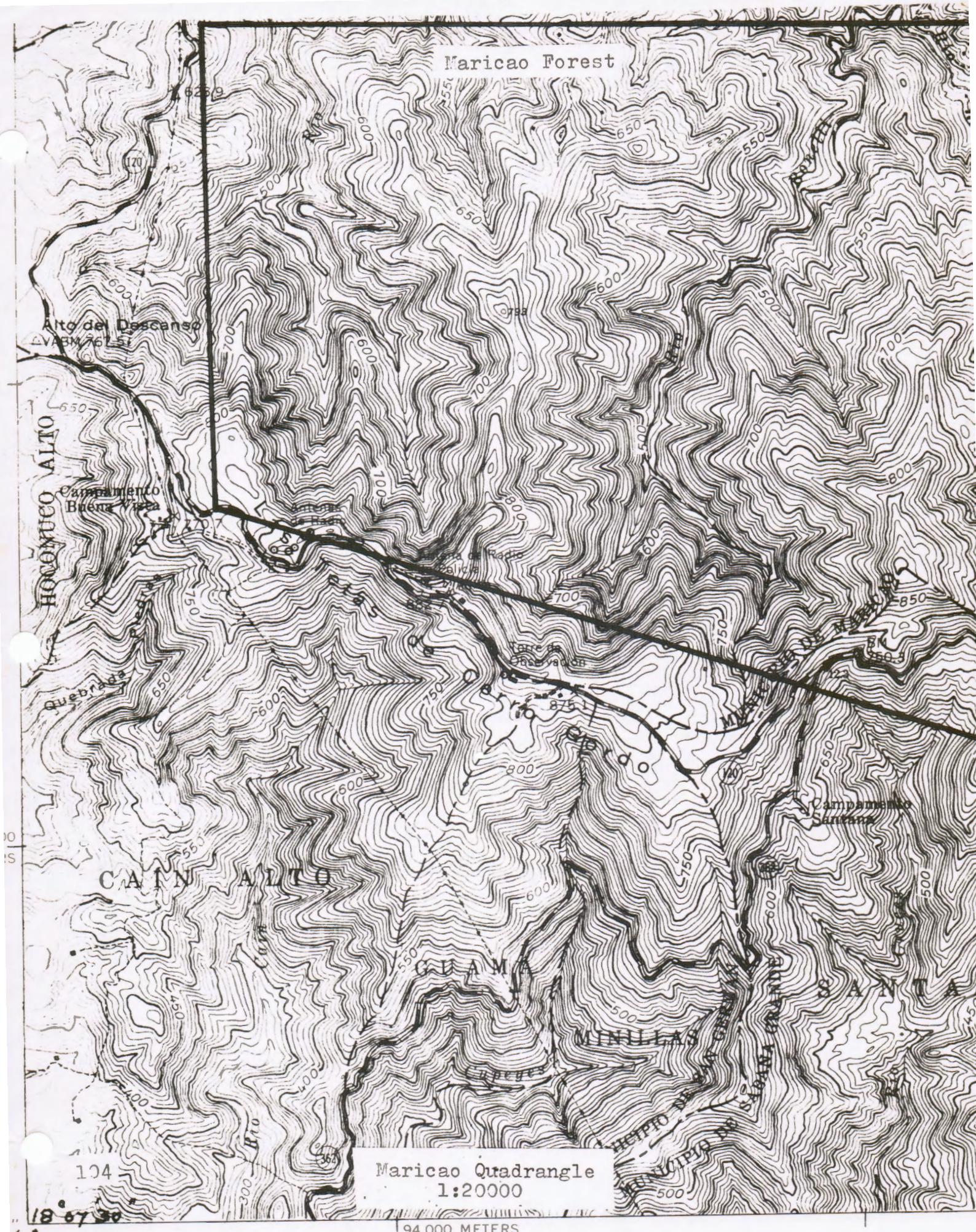
Recommendations

Only secondary priority is given to this area since its basic integrity is in doubt.

Themes emphasized: Tropical ecosystems.

Data Source: Dr. Roy Woodbury, Dr. D. Wilson

Other knowledgeable person: Dr. Frank Wadsworth


Maricao Forest
Alto del Descanso
VABM 761 5
HOCONUCO ALTO
Campamento Buena Vista
Quebrada
Torre de Observación
Cerro
Campamento Santana
CAIN ALTO
GUAMA
MINILLAS
SANTA
Río
Cuevas
Maricao Quadrangle
1:20000
94 000 METERS
104
18°07'30"
67°00'

Area Designation: Maricao Forest 2B

Location: Approximately 18°09' - 18°11'N
66°57' - 66°59'W
Maricao quadrangle (1:20,000)

Size: 10.5 sq. kms.

Ownership: Commonwealth of Puerto Rico

Current Land Use: Recreation, siting of antenna

Description of Natural Values

Geological

This forest is located on the main serpentinite body and some of the better exposures of this rock type, characteristic of island arcs, are found along the road. The higher points rise above 850 m. and magnificent views across the surrounding country are afforded.

Ecological

This is an area receiving about 250 cm. of rainfall. It supports a very diverse plant community with 123 endemic species and more than 40 rare and endangered species. There are about 850 species present. Many native land birds breed here, including lizard cuchoos, pearly-eyed thrasher, green mango humming bird, and loggerhead flycatcher. Also the Puerto Rican tanager is present in large numbers.

Area Integrity Danger

Possible danger from expansion of recreational facilities. The rock exposures will undoubtedly suffer from weathering as time proceeds.

Recommendations

It is recommended that consideration be given to this area as a natural landmark. However, it cannot be given high priority since its basic integrity has been damaged by deforestation and its

uniqueness consists mainly in the presence of serpentinite which will probably deteriorate with time.

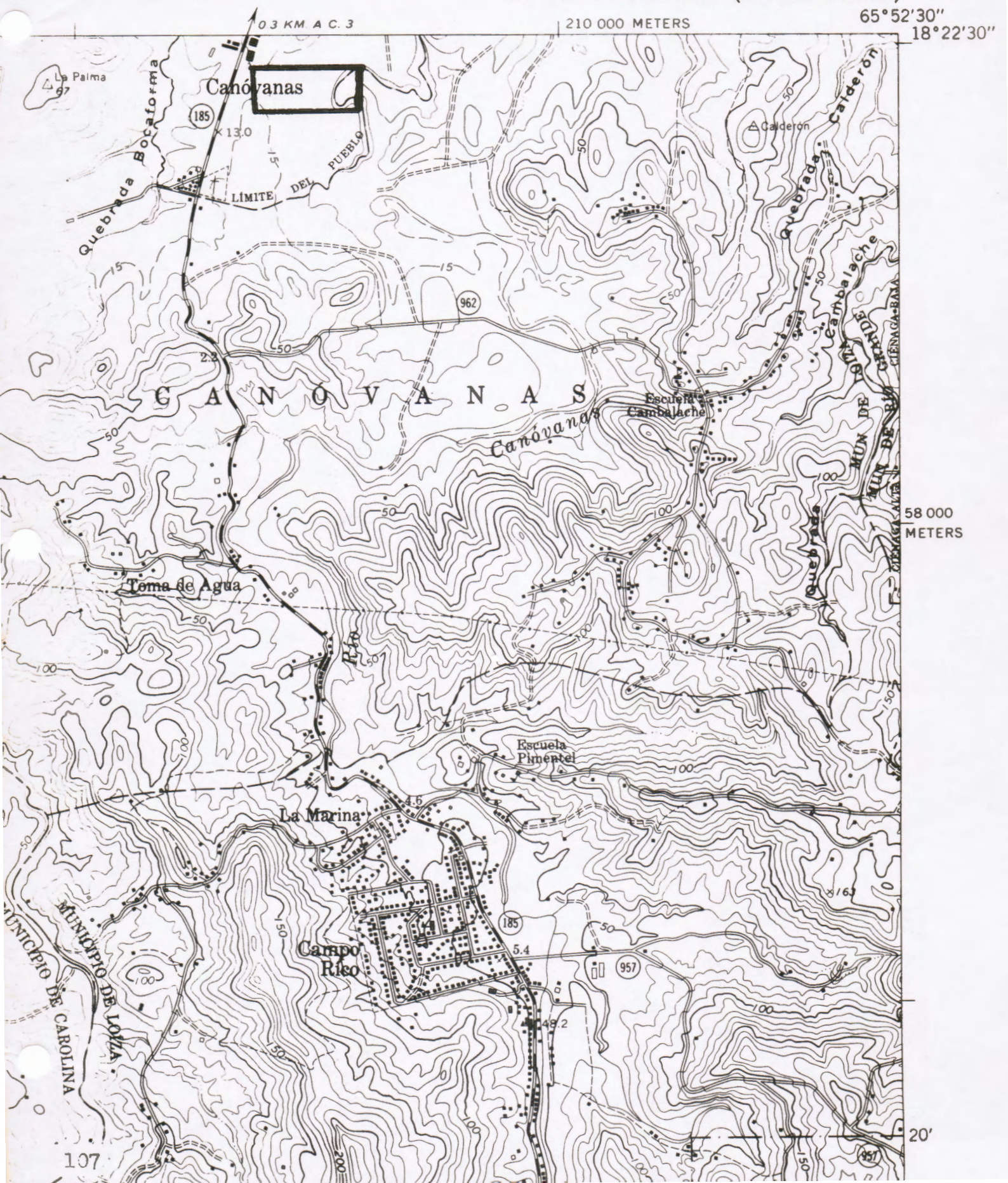
Themes emphasized: Mountains systems, PreCretaceous-Eocene geologic history, tropical ecosystem.

Data Source: Dr. Roy Woodbury; personal observation
Dr. D. Wilson

Other knowledgeable person: Dr. D. McIntyre

Canovanas Ausubo Forest

GURABO QUADRANGLE
PUERTO RICO
7.5 MINUTE SERIES (TOPOGRAPHIC)



Area Designation: Canovanas Ausubo Forest 2B

Location: Latitude 18°22'N, Longitude 65°54'N
Gurabo quadrangle (1:20,000)

Size: About .06 sq. km.

Ownership: Commonwealth of Puerto Rico

Current Land Use: Has been set aside as a possible park.

Description of Natural Values

Geology

The site is in the floodplain of Rio Canovanas and is underlain by clays which are commonly very moist. The surrounding rocks are volcanic sandstones and interbedded andesitic and basaltic pillow lavas of the Frailes formation of Upper Cretaceous age. The Frailes formation is here cut by mafic dikes of Upper Cretaceous or Tertiary age.

Ecology

This semimature small forest is the last remmant of a lowland rainforest dominated by Ausubo. The forest consists of 135 species, 59 of which are trees forming a continuous canopy at 65 to 70 feet. Eight species are over 20 in. in diameter and eighteen over 12 in. in diameter.

Area Integrity Danger

An urbanization has recently been built immediately to the north and the Government is considering making the site into a park. This will almost certainly result in damage. It is also liable to damage from hurricanes.

Recommendations

It certainly should be protected. There is some danger to its

integrity since there is a possibility of it being made into a recreational park.

Themes emphasized: Tropical ecosystems

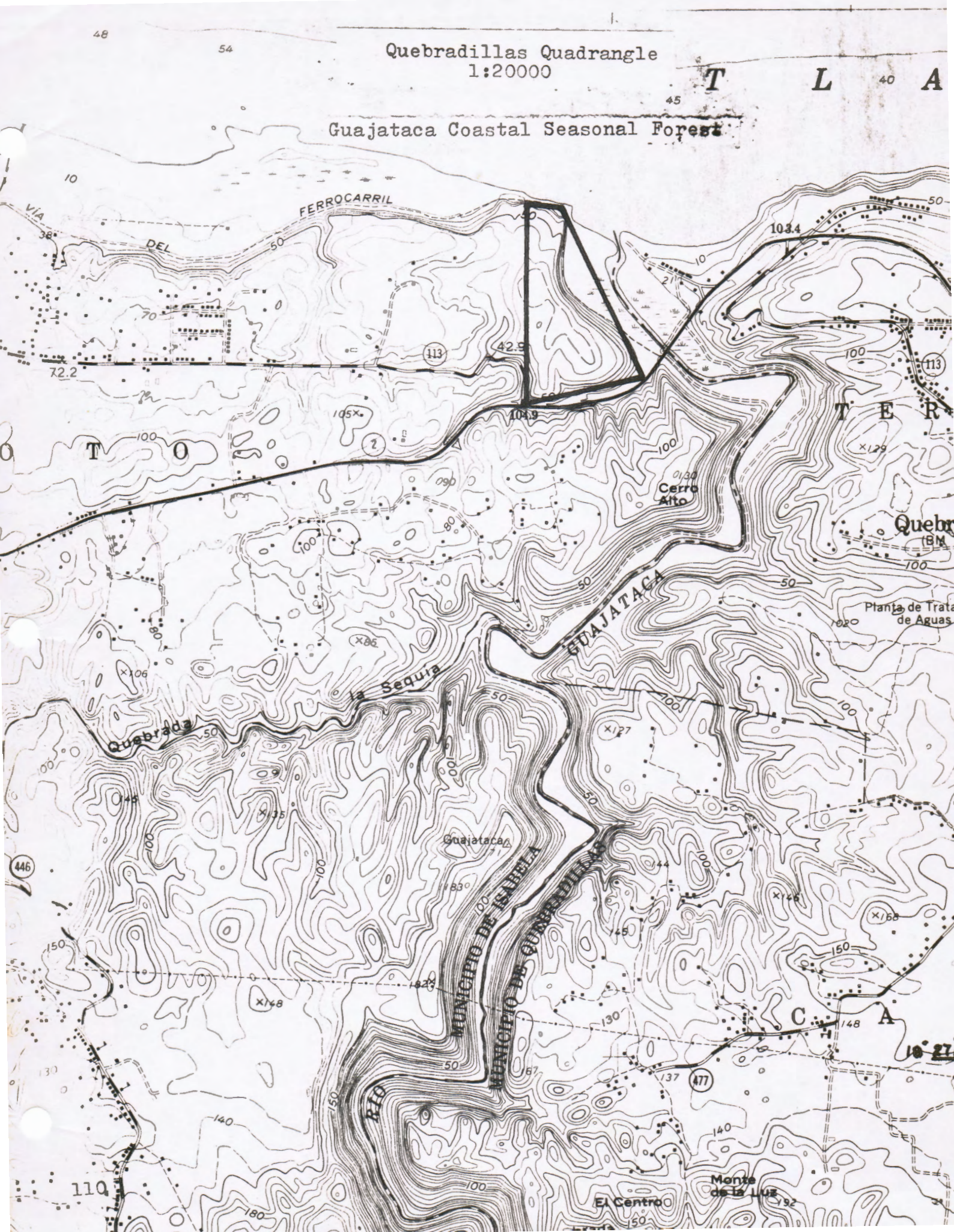
Reference: None known

Data Source: Dr. Roy Woodbury

Other knowledgeable person: None known

Quebradillas Quadrangle
1:20000

Guajataca Coastal Seasonal Forest



Area Designation: Guajataca Coastal seasonal forest 1B

Location: Latitude 18°29'N, Longitude 66°58'W
Quebradillas quadrangle (1:20,000)

Size: About .5 sq. kms.

Ownership: Private

Current Land Use: Natural forest

Description of Natural Values

Geology

This site is located on the outcrop of the Aymamon limestone, a very pure limestone of Miocene age. The limestone forms a cliff to the north through which a tunnel was constructed for the old, now defunct, railway.

Ecology

This seasonal forest (deciduous and semideciduous) is very unique in that it contains many species that have only been found in this location in Puerto Rico (and, of course, are not found elsewhere in the United States). It has over 400 species of vascular plants including 201 tree species. Fifty-two species are rare or endangered.

Area Integrity Danger

May be damaged due to land use pressures. A housing development is now being constructed on a nearby hill. Immediately to the northeast at the mouth of the Guajataca river is a beach very popular with tourists and local holiday makers.

Recommendations

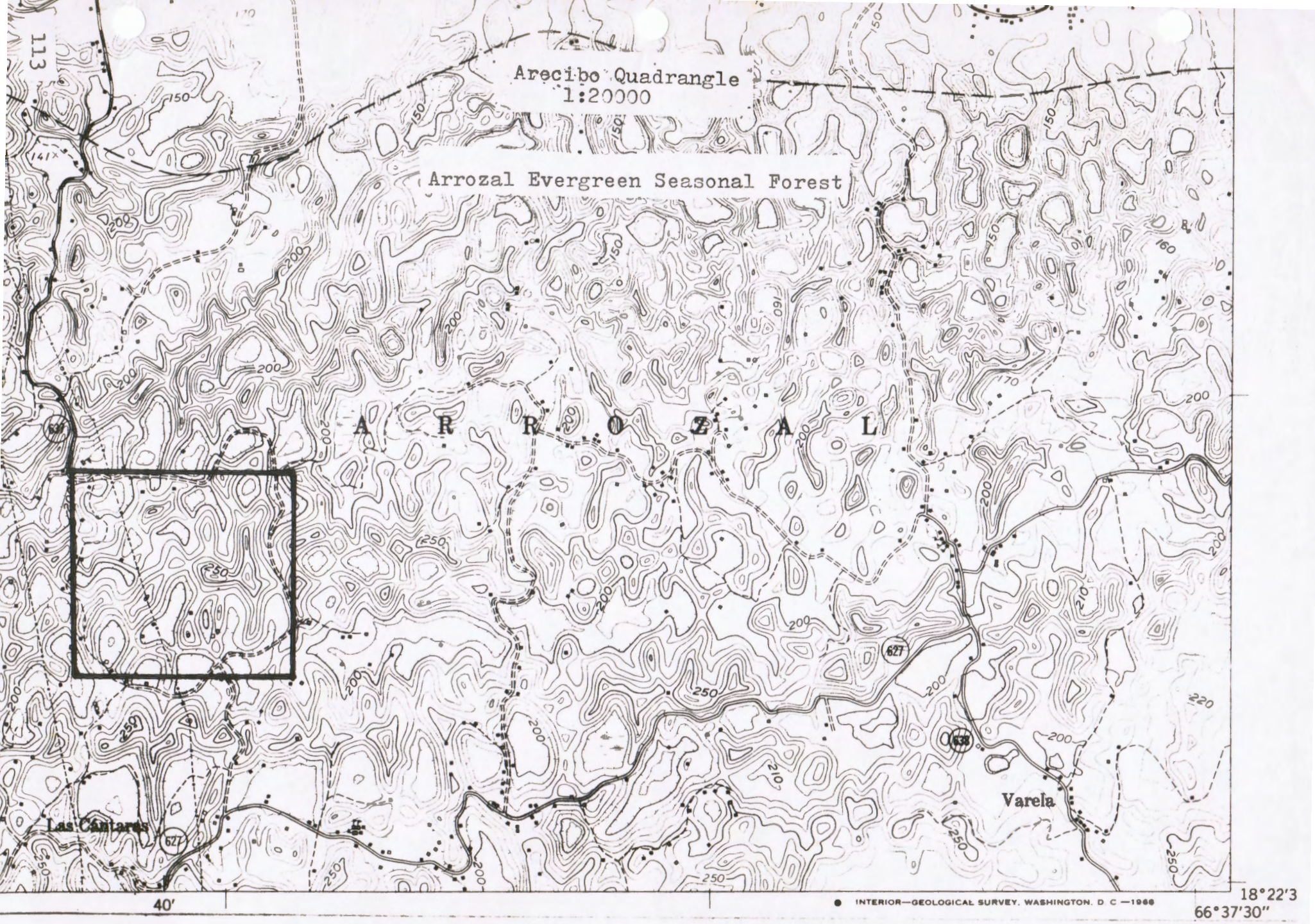
This site should be given high priority in view of the unique nature of its vegetation.

Themes emphasized: Tropical ecosystems; Oligocene to Recent geologic history

Reference: None known

Data Source: Dr. Roy Woodbury

Other knowledgeable person: None known


Arecibo Quadrangle
1:20000
Arrozal Evergreen Seasonal Forest
A R R O Z A L
Las Cámaras
Varela
627
638
40'
18°22'30"
66°37'30"
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D C —1966

Area Designation: Arrozal Evergreen seasonal forest 1L

Location: Latitude 18°23'N, Longitude 66°39'W
Arecibo quadrangle (1:20,000)

Size: About 1 sq. km.

Ownership: Private

Current Land Use: In a natural condition except for removal of a few trees for fence posts.

Description of Natural Values

Geology

This area is underlain by the Miocene Aguada limestone which is in places very fossiliferous, mainly molluscs and corals. It supports a well developed karst topography with several large sinkholes.

Ecology

The vegetation of the site is quite diversified in that it consists of over 450 species,of vascular plants, 188 of which are trees. Besides containing many rare species, there are many trees that reach their greatest size here. Twenty-nine species are over 1 ft. in diameter and eight are over 2 ft., twenty-five are over 70 ft. tall and eight are over 90 ft. Forty-six species are rare and endangered. The animal life is typical of mature moist limestone forests - lizards, including Anolis cuvieri, the Puerto Rican boa and birds, including the Lizard Cuckoo.

Area Integrity Danger

Due to existing land pressure there is always danger of building development. The continued felling of trees for fence posts may also cause some damage.

Recommendations

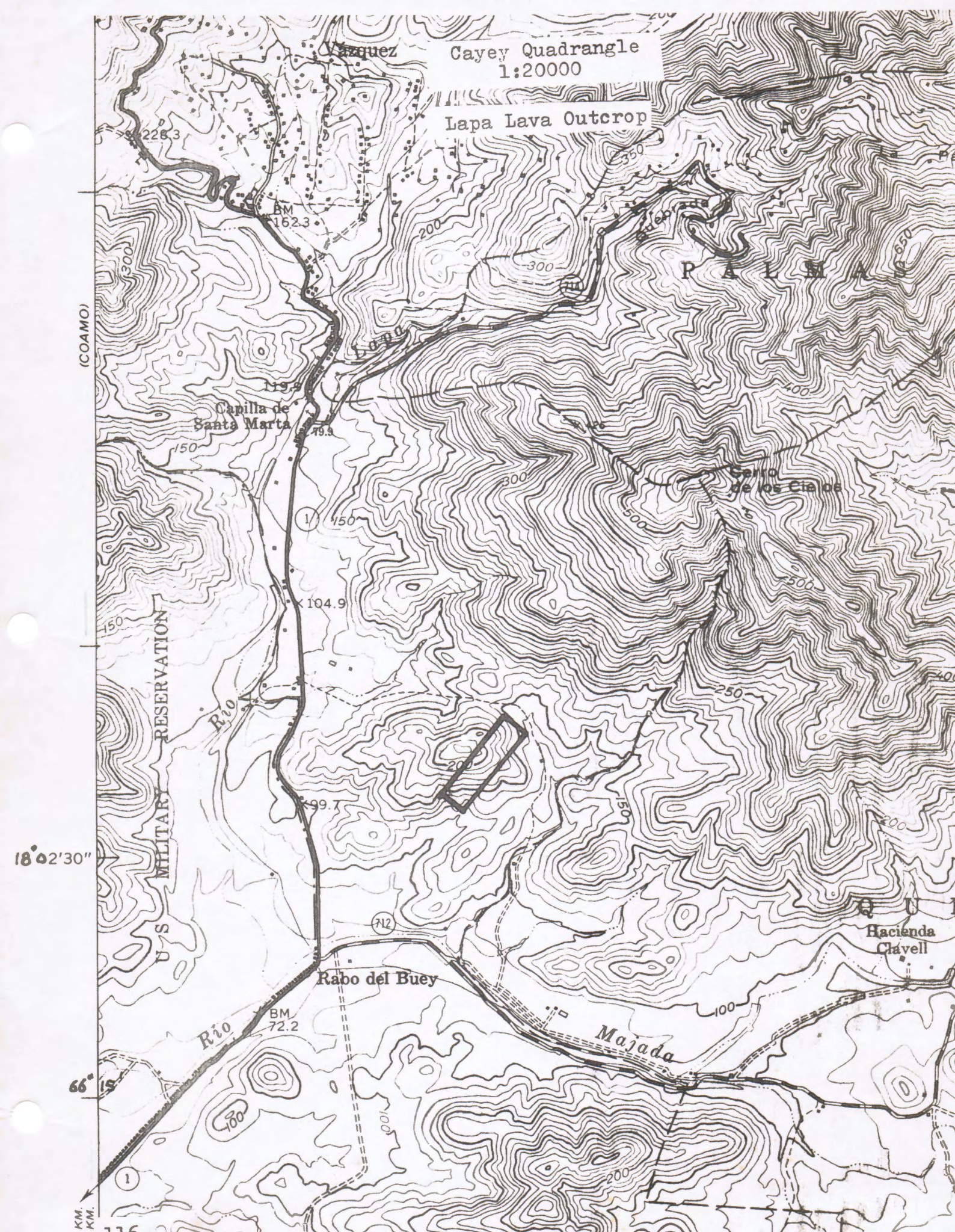
This site should be given high priority in view of its unique vegetation.

Themes emphasized: Tropical ecosystems; karst; Oligocene to Recent geologic history.

References: None known

Data Source: Dr. Roy Woodbury

Other knowledgeable person: Dr. Frank Wadsworth


Cayey Quadrangle
1:20000
Lapa Lava Outcrop
Vazquez
BM 162.3
PALMAS
Capilla de Santa Marta
Cerro de los Cielos
U.S. MILITARY RESERVATION
Rio
Rabo del Buey
BM 72.2
Majada
Hacienda Clavell
(COAMO)
18°02'30"
66° 15'

Area Designation: Lapa lava outcrop 2D

Location: Latitude 18°02'N, Longitude 66°14'W

Size: About .04 sq.km.

Ownership: Commonwealth of Puerto Rico

Current Land Use: nil

Description of Natural Values

Geology

This is a new road cut made in course of construction of the Las Americas expressway. The cut is in the Lapa lava member of the Robles formation of Santonian-Albian (Cretaceous) age. It is a lava of trachyandesitic composition and in this cut displays magnificent pillow structures, a characteristic of submarine flows. The pillows are up to two or more meters in diameter.

Area Integrity Danger

There is little danger that this site will be damaged by human activity since it is forbidden to stop cars along the highway except in emergencies. However, the rock will undoubtedly become badly weathered with the passage of time though the pillow structures will probably remain clearly visible.

Recommendations

Since this is an artificial cut it is doubtful whether it can be given the status of a natural landmark. Nevertheless it is undoubtedly the best visible example of the older submarine lava flows.

Themes emphasized: igneous activity

References

Glover, Lynn, 1971. Geology of the Coamo Area, Puerto Rico and its

Relation to the Volcanic Arc-Trench Association. U.S. Geol. Sur., Prof. Paper 636, p. 14-16.

Data Source: Personal observation

Other knowledgeable person: Dr. Alan L. Smith

66°27'30"
Manati Quadrangle
1: 20000
Laguna Tortuguero
PUERTO DEL TORTUGUERO
PISTA DE ATERRIZAJE
Escuela Alejandrina Benitez
MUNICIPIO DE MANATI
MUNICIPIO DE VEGA BAJA
Y E G U A D A
Tanque de Agua
LAGUNA TORTUGUERO
El Pulguero
NUEVAS SALIENTE
Laguna Rica
Coto Norte
686
687

Area Designation:	Laguna Tortuguero 2A
Location:	18°27'N - 66°W Manati quadrangle (1:20,000)
Size:	Approximately 21 sq. kms.
Ownership:	Partly Commonwealth of Puerto Rico, partly private
Current Land Use:	Grazing, fishing, extraction of sand for construction, eastern part National Guard Reservation

Description of Natural Values

Geologic

The lagoon itself, approximately 5 kms. long by 1 km. in width, is surrounded by swamp deposits and blanket sands of Quaternary age. To the south a few rounded hills of Aymamon (Miocene) limestone rise through these superficial deposits.

Ecological

The lagoon and its surroundings support unique communities of animals and plants. Of 21 species of fish 17 are endemic. Twenty-three species of mollusca, 22 species of crustacea and 27 insect species are recovered. Four out of 39 species of birds are endemic. Of the plant life 672 species have been identified including trees, grasses, sedges, orchids and ferns. At least 37 species are endemic and 104 are rare and endangered.

Area Integrity Danger

A large part of this area has already been degraded by uncontrolled extraction of sand. There are one or two small patches still undisturbed but if steps are not taken immediately these will probably be destroyed.

Eligibility for Natural Landmark Status

This area certainly contains a unique fauna and flora. However, it has been badly disturbed and cannot be given top priority.

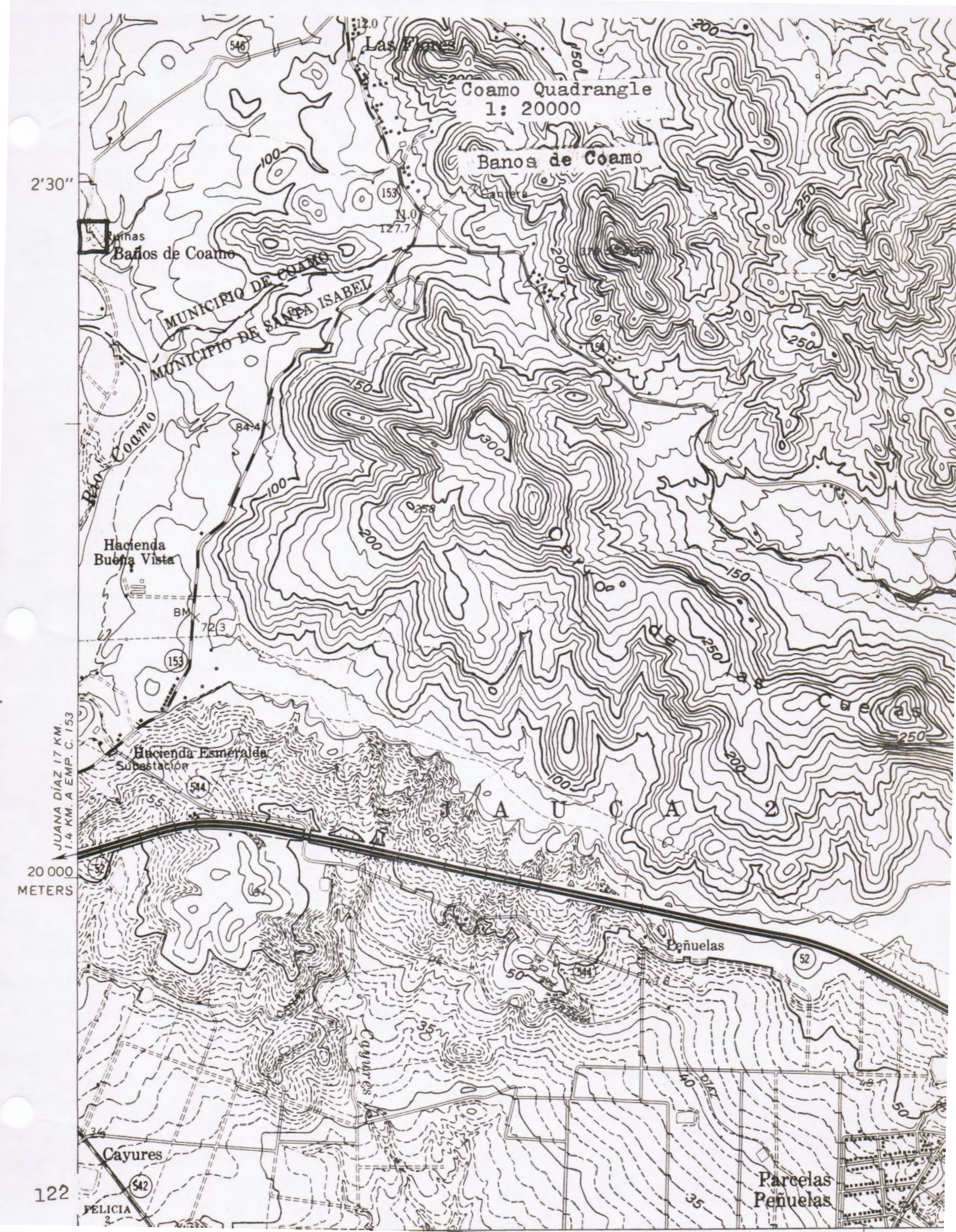
Themes emphasized: Lagoons, tropical ecosystems

Published Reference

Reyes de Ruiz, N.B., 1971. Estudio Ecologico de la Laguna Tortuguero, Puerto Rico. Water Resources Institute, University of Puerto Rico, Mayaguez, P.R., 119p.

Data Source: Dr. Roy Woodbury

Other knowledgeable person: Dr. Gustavo Candelas


Coamo Quadrangle
1: 20000
Baños de Coamo
Las Flores
Ruinas
Baños de Coamo
MUNICIPIO DE COAMO
MUNICIPIO DE SANTA ISABEL
Río Coamo
Hacienda Buena Vista
Hacienda Esmeralda Subestación
Peñuelas
Cayures
Parcelas Peñuelas
Cuevas
546
153
544
52
344
542
2'30"
20 000 METERS
JUANA DÍAZ 17 KM.
1.4 KM. A EMP. C. 153
122

Area Designation: Bano de Coamo 4

Location: 18°02'29"N - 66°22'30"W

Size: About .01 sq. km.

Ownership: Commonwealth of Puerto Rico and Sucesion Arturo Pico

Current Land Use: Farming

Description of Natural Values

Geology

The geology of the area is complicated and consists of Cretaceous volcaniclastic rocks of the Coamo formation disturbed by numerous faults and largely covered in this area by alluvium.

A spring, issuing naturally, delivers mineralized water at temperature of about 44°C.

A bath house was erected over the spring and of recent years fell into a state of dilapidation. There are plans to renovate it and convert it into a government run guesthouse.

A well dug in 1969 on the neighboring farm (Finca Troche) to 300 ft. struck artesian water at a temperature a little below that of the natural spring. Analyses of the waters from both the well and the spring are:

	Bano de Coamo	Finca Troche
pH	8.85	8.9
K	4.80 ppm	4.10 ppm
Ca	220.00 ppm	166.00 ppm
Mg	.70 ppm	.70 ppm
Fg	0.0 ppm	.00 ppm
Na	250.00 ppm	250.0 ppm

H_2S	.16 ppm	.09 ppm
Sulfates	1120.00 ppm	850. ppm
Solids	1963.5 ppm	1515. ppm

Area Integrity Danger

The integrity of the natural spring is already destroyed by the construction of the bath house and the neighboring well has no original integrity.

Eligibility for Natural Landmark Status - not recommended

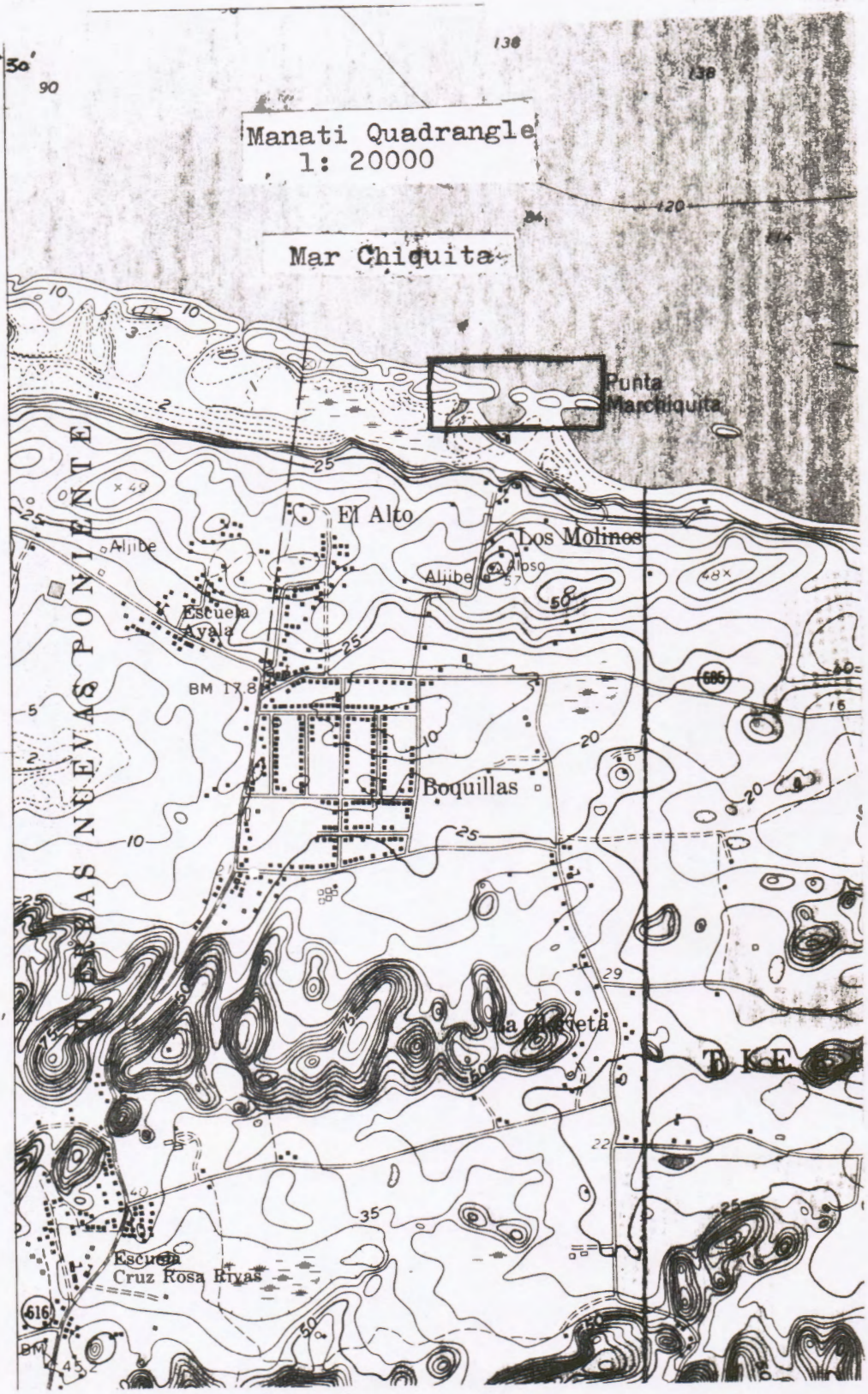
Themes emphasized: Hot water phenomena.

Published References

Hodge, E.T., 1920. Geology of the Coamo - Guayama District. Sci. Surv. Porto Rico and the Virgin Is. N.Y. Academy oc Sciences.

Data Source: Reference above and Dr. R. Pico

Other knowledgeable person: Dr. E. Aguilar


66°30'
Manati Quadrangle
1: 20000
Mar Chiquita
Punta Marchiquita
El Alto
Los Molinos
Aljibe
Aljibe
Aljibe
Escuela Ayala
BM 17.8
Boquillas
La Vereda
Escuela Cruz Rosa Rivas
BM
616
685
18°27'30"

125

Area Designation: Mar Chiquita 3C

Location: On coast north of Manati, approx. 18°28'30"N 66°29'W. Manati quadrangle (1:20,000).

Size: about .10 sq. km.

Ownership: Commonwealth of Puerto Rico.

Current Land Use: nil - occasionally recreational.

Description of Natural Values

This is a small almost completely circular bay about 135 m in diameter and almost comletely enclosed to seaward by ridges of eolianite or old cemented windblown sand. The sea enters by a small gap in the ridge about 6 to 7 m wide. The almost circular form of the bay is probably due to the diffraction pattern of the waves as they emerge from the narrow opening breached in the ridge. An additional point of interest is that the waves reflected from the shore are in resonance with those entering from seaward so that quite large waves are built up.

The ridge and the old cliff behind the beach are good examples of younger and older Pleistocene calcium carbonate cemented dunes which are a feature of Puerto Rican coastal geology particularly along the north coast.

Area Integrity Danger

There were some huts along the shore but these are not now occupied and are in a state of collapse. There is little danger except from possible increase in use for recreation.

Recommendations

This is an interesting and scenic locality and is illustrative of unique coastal form, i.e. a lunate resonating bay; however, it is not thought to rate higher than priority 3.

Themes emphasized: Seashore, Oligocene-Recent geologic history.

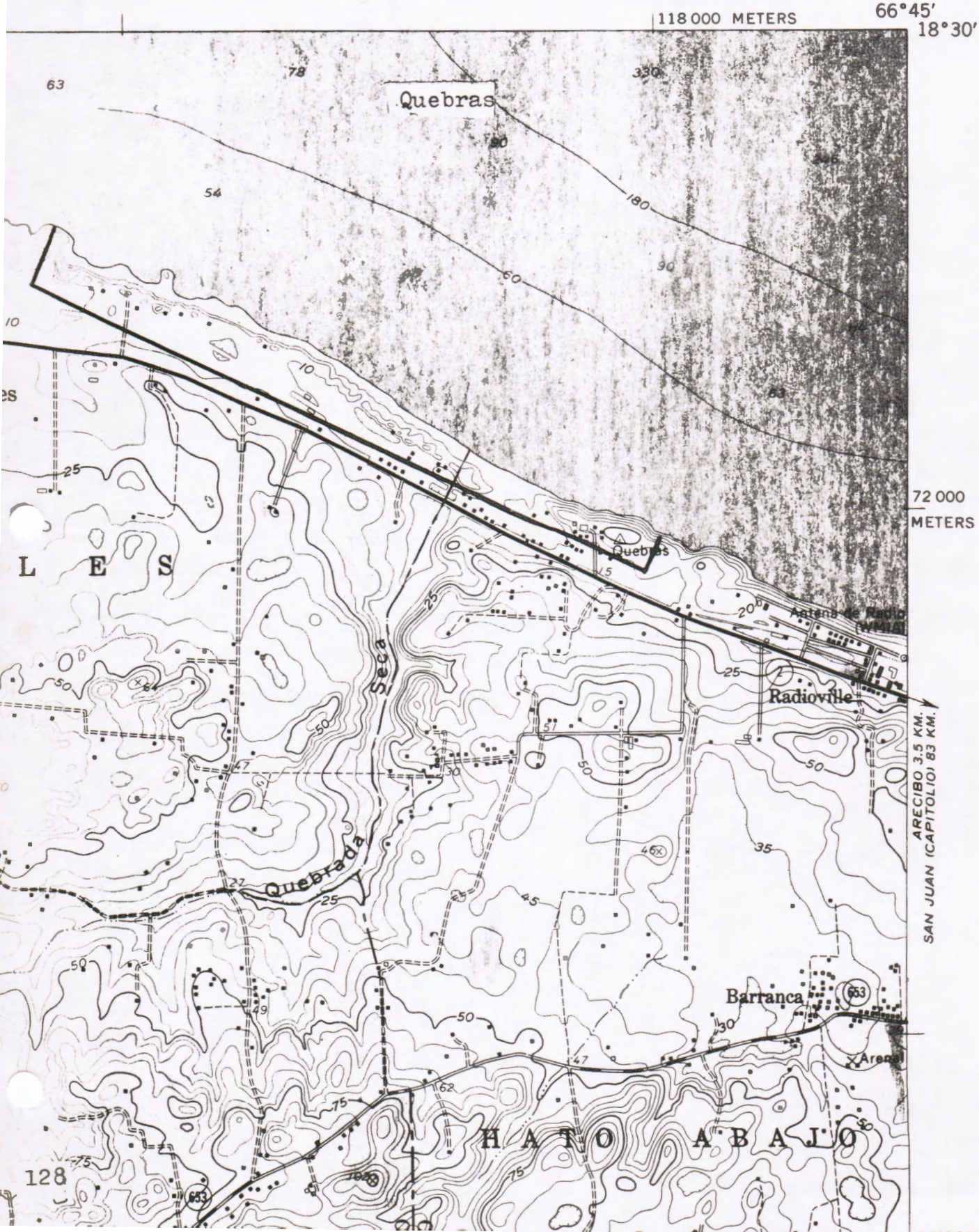
Selected References:

Kaye, C.A., 1959. Shoreline Features and Quaternary Shoreline changes Puerto Rico. U.S. Geol. Surv. Prof. Paper 317-B, p. 49-140.

Data Sources: Personal observation; above reference.

Other knowledge person: Dr. Giorgio Pannella.

CAMUY QUADRANGLE
PUERTO RICO
7.5 MINUTE SERIES (TOPOGRAPHIC)



Area Designation: Sand dunes at Quebras 4

Location: East of Hatillo (approx. 18°29'N 66°46'W) Camuy quadrangle (1:20000).

Size: Approx. .5 sq. km.

Ownership: Commonwealth of Puerto Rico

Current Land Use: Sand extraction.

Description of Natural Values

Recent sand dunes extend along a narrow stip of the coast in this locality for several kilometers. They consist of fine, wind-blown sand, mostly, shell fragments and quartz. They are mostly 5-10 meters in height and are stabilised by vegetation. Underlying part of the area are indurated (calcium carbonate cemented) Pleistocene eolianites.

Area Integrity Danger

The dunes have been already extensively damage by extraction of sand - much of it probably illegal.

Theme emphasized: Sand dunes.

Elegibility for landmark status

Not recommended. The dune forms have already been damaged and they are not particularly unique or impressive.

References:

Monroe, Watson H., 1963. Geology of the Camuy quadrangle, Puerto Rico. U.S. Geol. Surv., Map GQ-197.

Data Source: Personal Observation.

Other knowledge person: M. Watson, H. Monroe.

Appendices

A - References

B - Alphabetical Index of Sites

C - Index of Sites by Themes or Sub-themes

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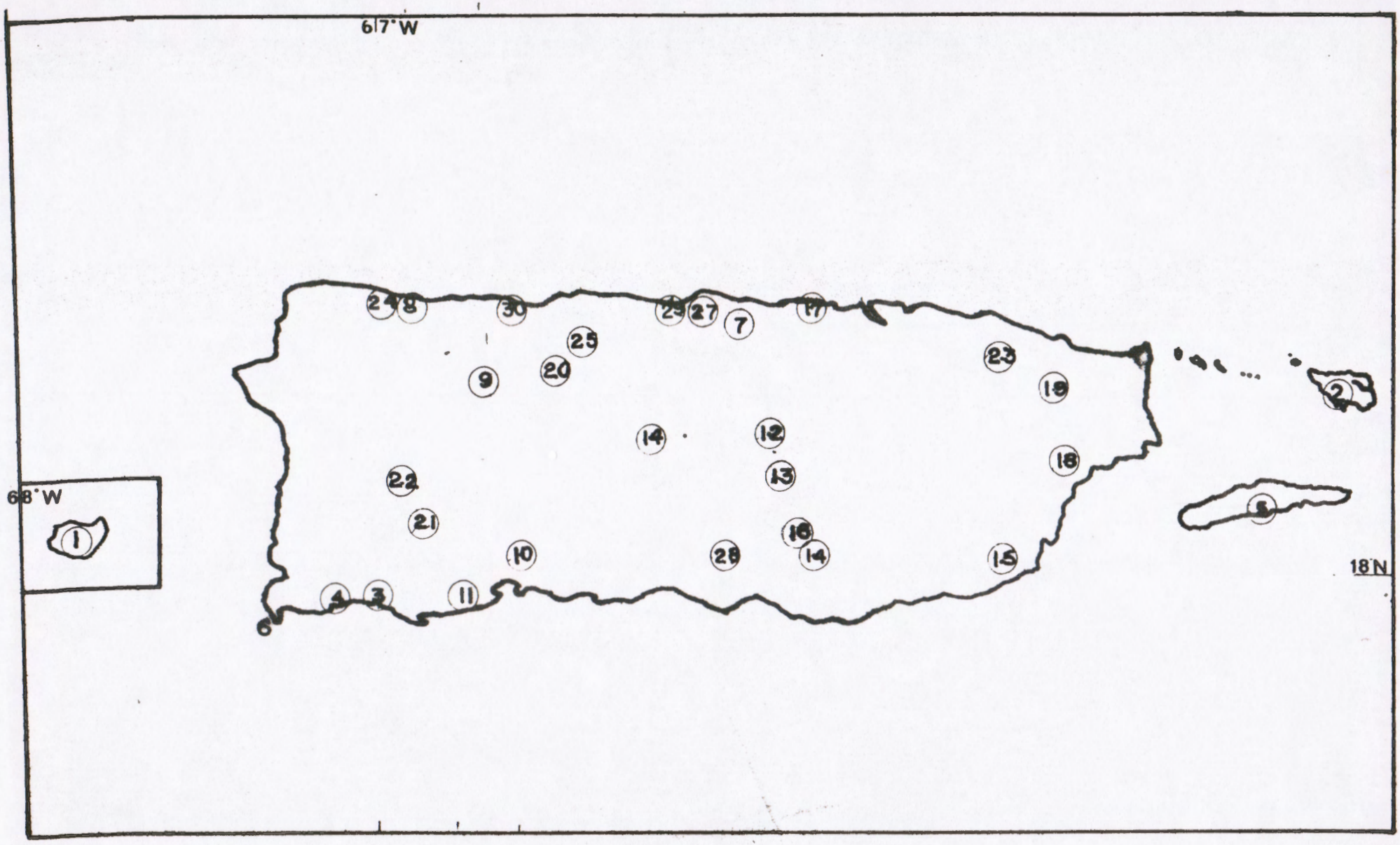
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25	Arrozal Evergreen Seasonal Forest	Tropical Ecosystem; Karstic phenomena; Oligocene-Recent Geologic History	1D	114
3	Bahia Fosforescente	Seashore; Coral Reffs; Luminescent Bays; Marine Environments	1B	33
4	Bahia Monsio Jose	Lagoons; Luminescent Bays	2A	36
28	Banos de Coamo	Hot Water phenomena	4	123
12	Barrancas Quarry	Cuestas; Mountain System; Pre-Cretaceous-Eocene Geologic History	2B	70
7	Bario Almirante	Karstic phenomena; Oligocene-Recent Geologic History	1C	45
6	Cabo Rojo	Seashore; Islands; Semi-arid Ecosystem	2B	42
23	Canovanas Ausubo Forest	Tropical Ecosystem	2B	108
8	Canon de Guajataca	Karstic phenomena; Tropical Ecosystem	1D	49
13	Canon de San Cristobal	Plains; Plateau; Mountain System; River System and Lakes	2D	73
15	Cerro La Pandura	Mountain System; Tropical Ecosystem	1D	81
2	Culebra Is.; Is. of Culebrita and adjacent Cayo including Cordillera and Cayo Icacos	Seashore; Islands; Coral Islands; Reefs; Lagoons; Marine Enviroments; Semi-arid Ecosystem Geologic History	1D	27

Map Location No.	Area designation	Theme emphasized	Priority	Page
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11	Guanica	Karstic phenomena; Karstic and Underground Ecosystem; Seashore; Semi-arid Ecosystem	1C	63
27	Laguna Tortuguero	Lagoons; Tropical Ecosystem	2A	120
26	Lapa Lava Outcrop	Igneous activity	2D	117
16	Las Piedras Chiquitas	Mountain System; Tropical Ecosystem; Pre-Cretaceous-Eocene Geologic History	1B	85
14	Los Tres Picachos	Mountain System; Tropical Ecosystem; Pre-Cretaceous-Eocene Geologic History	1D	76
19	Luquillo Esperimental Forest	Mountain System; Tropical Ecosystem	1C	94
29	Mar Chiquita	Seashore; Oligocene-Recent Geologic History	3C	126
22	Maricao Forest	Mountain System; Tropical Ecosystem; Pre-Cretaceous-Eocene Geologic History	2B	105
1	Mona and Monito Islands	Seashores; Islands; Coral Islands; Reefs; Lagoons; Marine Environments	*	19
17	Nevaris Hills	Karstic phenomena; Tropical Ecosystem	2D	89
5	Puerto Mosquito	Seashore; Marine Environment; Luminescent Bays	1C	39

Map location No.	Area designation	Theme emphasized	Priority	Page
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30	Quebras	Eolian landforms	4	129
20	Rio Abajo Forest	Cuestas; karstic phenomena; Tropical Ecosystem; Oligocene-Recent Geologic History	1D	100
9	Rio Camuy Caves	Karstic phenomena; Karstic and Underground Ecosystem	1C	53
21	Susua Forest	Tropical Ecosystem	2D	103

* Now approved Natural Landmark.

Index by Themes or Sub-themes

Theme or Sub-theme	Area designation	Priority Rating	Map Location No.	Page
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	Mar Chiquita	3C	29	126
	Mona and Monito Is.	*	1	19
	Puerto Mosquito	1C	5	39
b. Coral Islands, reefs	Bahia Fosforescente	1B	3	33
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	Mona and Monito Is.	*	1	19
c. Estuaries, lagoons, luminescent bays	Bahia Fosforescente	1B	3	33
	Bahia Monsio Jose	2A	4	36
	Culebra and Adjacent Islands	1D	2	27
	Mar Chiquita	3C	29	126
	Laguna Tortuguero	2A	27	120
	Puerto Mosquito	1C	5	39
d. Marine Environment	Bahia Fosforescente	1B	3	33
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	Puerto Mosquito	1C	5	39
2. Terrestrial Geology and Ecology				
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b. Cuestas	Barrancas Quarry	2B	12	70
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Index by Themes or Sub-themes

Theme or Sub-theme	Area designation	Priority Rating	Map Location No.	Page
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	Luquillo Experimental Forest	1C	19	94
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d. Works of igneous activity	Lapa Lava outcrop	2D	26	117
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	Canon de Guajataca	1D	8	49
	Guanica Forest	1C	11	63
	Nevaris Hills	2D	17	89
	Quebrada de Los Cedros	2B	10	58
	Rio Abajo Forest	1D	20	100
	Rio Camuy Caves	1C	9	53
i. Pre-Cretaceous-Eocene Geologic History	Barrancas Quarry	2B	12	70
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	Las Piedras Chiquitas	1B	16	85
	Los Tres Picachos	1D	14	76
	Maricao Forest	2B	22	105

Index by Themes or Sub-themes

Theme or Sub-theme	Area designation	Priority Rating	Map Location	Page
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	Rio Abajo Forest	1D	20	100
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	Canon de San Cristobal	2D	13	73
	Canovanas Ausubo Forest	2B	23	108
	Cerro La Pandura	1D	15	81
	Guajataca Coastal Seasonal Forest	1B	24	111
	Laguna Tortuguero	2A	27	120
	Las Piedras Chiquitas	1B	16	85
	Los Tres Picachos	1D	14	76
	Luquillo Experimental Forest	1C	19	94
	Maricao Forest	2B	22	105
	Nevaris Hills	2D	17	89
	Rio Abajo Forest	1D	20	100
	Susua Forest	2D	21	103
l. Semi-arid Ecosystem	Cabo Rojo	2B	6	42
	Culebra and Adjacent Islands	1D	2	27
	Guanica Forest	1C	11	63
	Mona and Monito Is.	*	1	19
m. Karstic and Underwater Ecosystem	Guanica Forest	1C	11	63
	Rio Camuy Caves	1C	9	53